March

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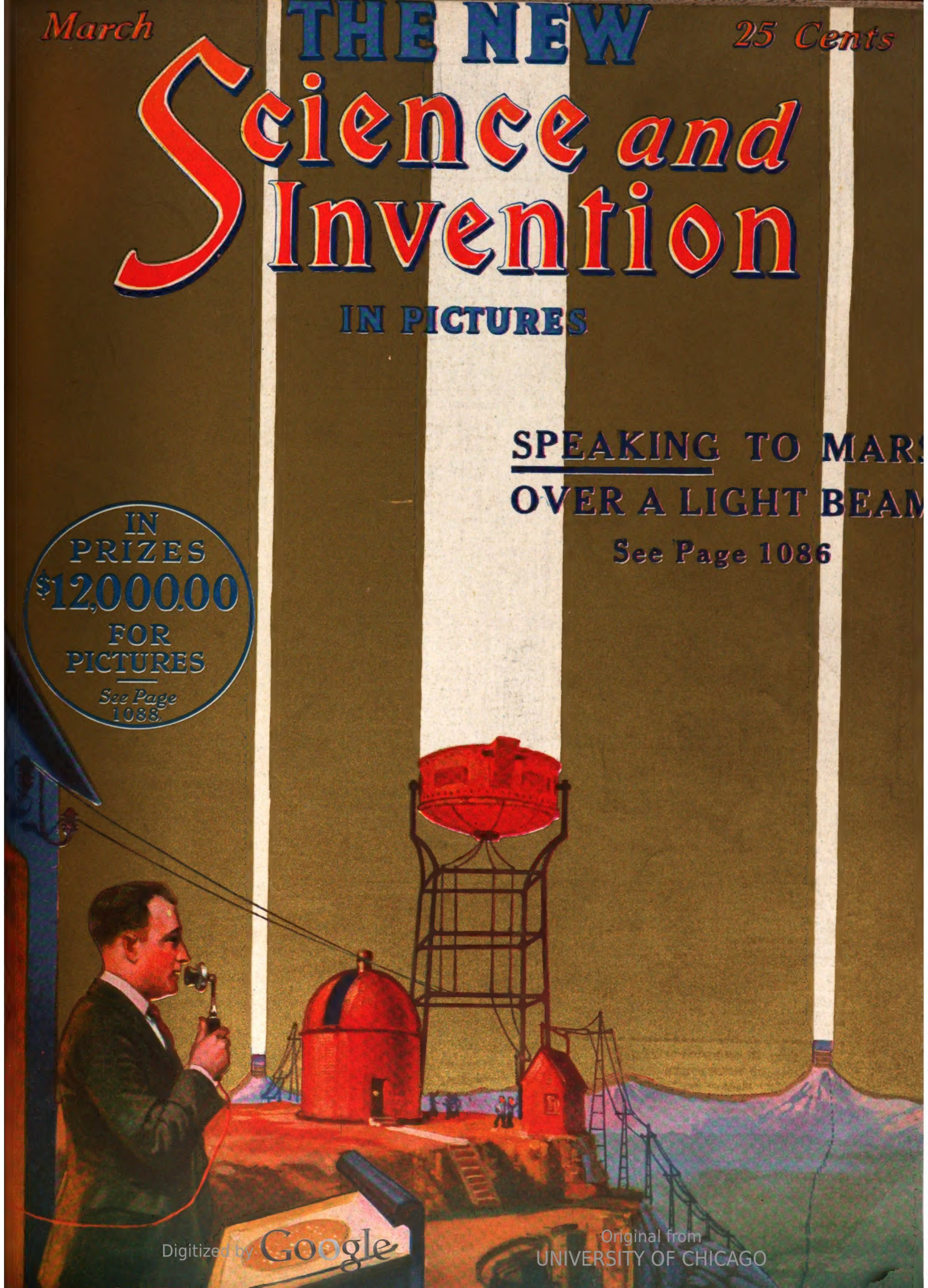

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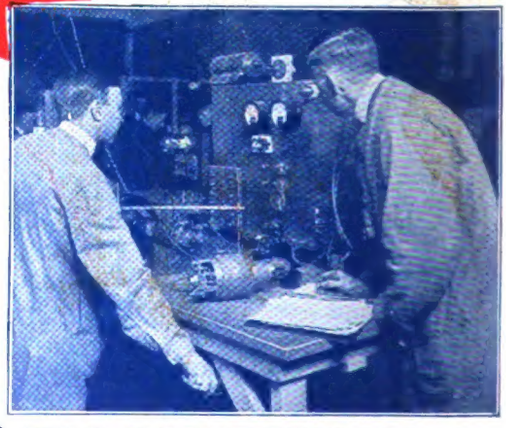

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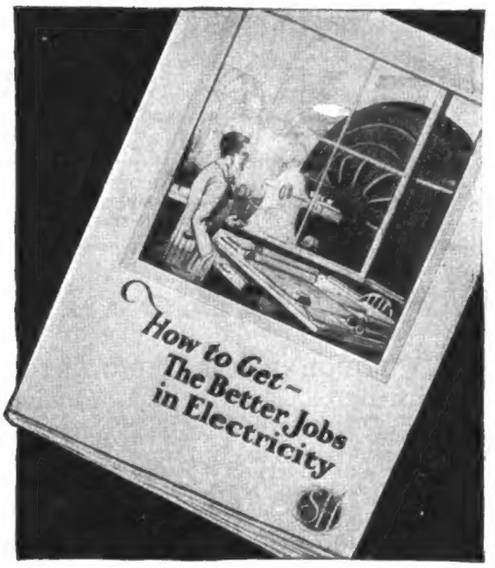

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"I guarantee that the new method which penetrates to the starved root cells will produce a new, healthy growth of hair in 30 days or your money will be refunded. And furthermore, I want you as the user to be the sole judge. My special free book, now ready, explains the method in detail and tells you precisely why I am able to make this unusual free proof guarantee."

ALOIS MERKE.

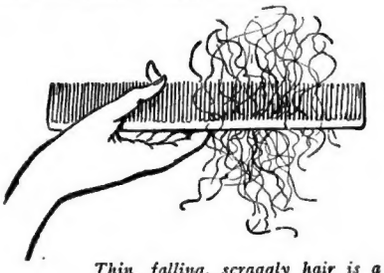
New Hair in 30 Days -or Costs You Nothing!

Alois Merke discovers a new, simple method guaranteed to grow thick, beautiful, luxuriant hair, or money instantly refunded. Gives new life and health to hair that is thin, falling, lifeless.

At the Famous Merke Institute, Fifth Avenue, New York, letters are pouring in from all over the country requesting information concerning this new method for growing hair. So successful is it that it has been guaranteed to grow new hair in 30 days *or cost nothing!*

To women this method is particularly interesting, as it often transforms thin, falling hair into rich, luxuriant beauty in an unbelievably short time. It is unlike anything ever known in this country. It penetrates to the starved root cells, revitalizes and nourishes them—and the hair grows thick, lustrous, beautiful.

There is no massaging, no singeing, no unnecessary fuss or bother of any kind connected with this new method. It is simple, pleasant. Already hundreds of women who had thin, falling hair, hundreds of men who were "thin on top," have acquired new luxuriant growths of hair. Often the results are almost unbelievable.



Thin, falling, scraggly hair is a sign of starved root cells. But now a method has been perfected which penetrates to these cells and stimulates them into new activity.

Thin Falling Hair Given Glorious New Health

Is your hair thin, lifeless? Does it fall out, break? Is it dull and without lustre?

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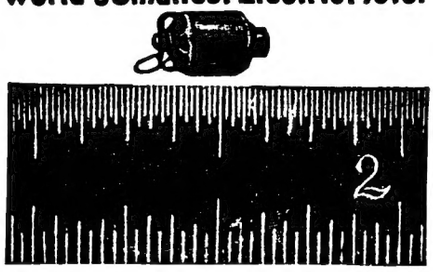
$200 Miniature Electric Prize Contest

THIS prize contest conducted by PRACTICAL ELECTRICS magazine, promises to be one of the most interesting that has been staged in recent years.

Here at last is something worth while. Not only can you win an attractive prize, but you will derive a tremendous amount of personal satisfaction from this contest. The illustration on this page shows the smallest electrical motor that has been built. Its dimensions are as follows: 11/64" high; 19/64" long. It weighs 5.5 grains.

This little motor is along the lines of our new contest except that we will not be quite so hard on the participants. *We require miniature electric models, the largest dimensions of which must not be more than ¾".* Any electrical appliance, any electrical apparatus, any radio instrument that will be reproduced *in a working condition* in miniature, is eligible for entry in this contest.

World's Smallest Electric Motor



Total weight slightly above 5 grains. The tiny armature, .09" in diameter, has 4 pole pieces and is wound with No. 40 silk copper wire. Silver brushes are used. The over-all dimensions of the motor measure 19-64" long and 11-64" high. When connected to a small flash light battery, the motor runs at a very high speed.

$200 IN GOLD

First Prize	$75
Second Prize	50
Third Prize	20
Fourth Prize	20
Fifth Prize	10
Sixth Prize	10
Seventh Prize	5
Eighth Prize	5
Ninth Prize	5

The judges will welcome miniature models of the following: Electric bells, switches, all kinds of electric heating appliances, electric generators, telephones, microphones, telephone desk stands, telegraph instruments, any and all radio apparatus, static machines, electric lamps, batteries, rheostats, measuring instruments, fans, transformers, in fact any electrical apparatus or electrical appliance. *One of the rules of the contest is that the miniature models must work.* Dummies cannot be entered in this contest The builders of these miniature models will come in for a goodly share of publicity as many newspapers and periodicals will feature these models.

There is still time to enter into this contest—it closes March 15th.

Full particulars, for entering the miniature models in this contest, closing date, rules and restrictions, etc., will be found in full in the March issue of PRACTICAL ELECTRICS.

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INTERESTING ARTICLES TO APPEAR IN MARCH ISSUE OF "PRACTICAL ELECTRICS"

Photo-Electric Telephony
By Dr. A. Gradenwitz, Berlin, Germany

Solar Radiation Measurement
By H. H. Kimball and H. E. Hobbs, U. S. Weather Bureau

Television by Belin System
By Lucien Fournier, Paris, France

Electric Clock Runs 1000 Years

Submarine Pilot Cable
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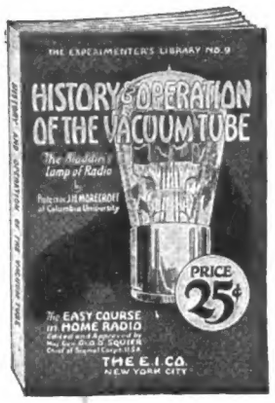
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History and Operation of the Vacuum Tube

By PROF. J. H. MORECROFT

Associate Professor of Electrical Engineering, Columbia University

Edited and Approved by

MAJOR GENERAL GEO. O. SQUIER, Chief of the Signal Corps, U. S. A.

This book serves an interesting study of the fundamental principles, historical evolution, and practical application of the vacuum tube as used in radio apparatus of every description. Since the vacuum tube is one of the most important parts in the modern radio set, and has been largely responsible for making present-day radio entertainment possible, this book has been entirely devoted to the subject of that one particular instrument. It is written in simple everyday language with all technical terms thoroughly explained so as to make matters easily understood by everyone.

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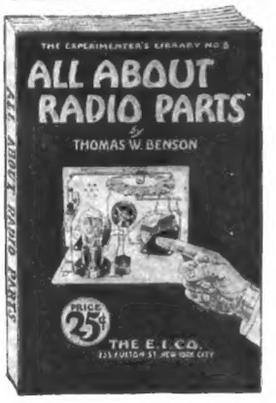

All About Radio Parts

By THOMAS W. BENSON

This book gives an extensive description of the various parts used in all types of receivers, especially explaining the features of certain apparatus and circuits. It also describes why the different parts are used and how they operate. There has been nothing overlooked.

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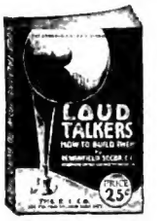

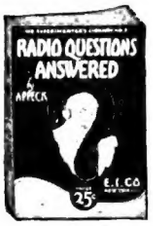

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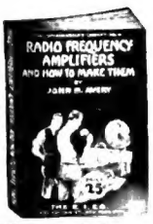

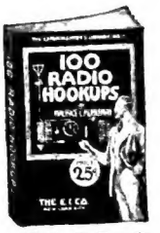

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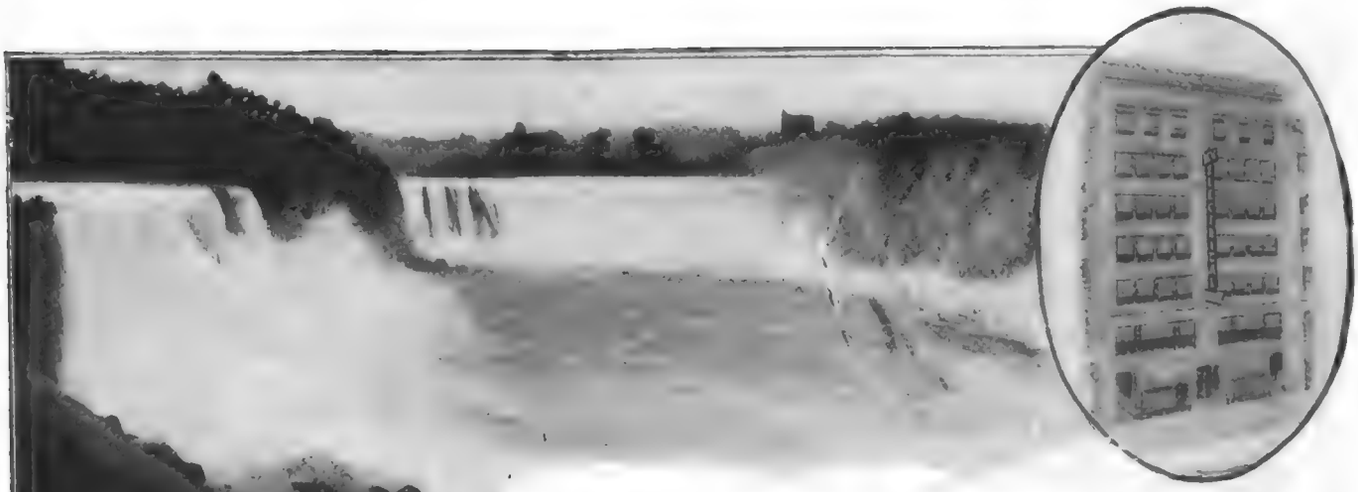

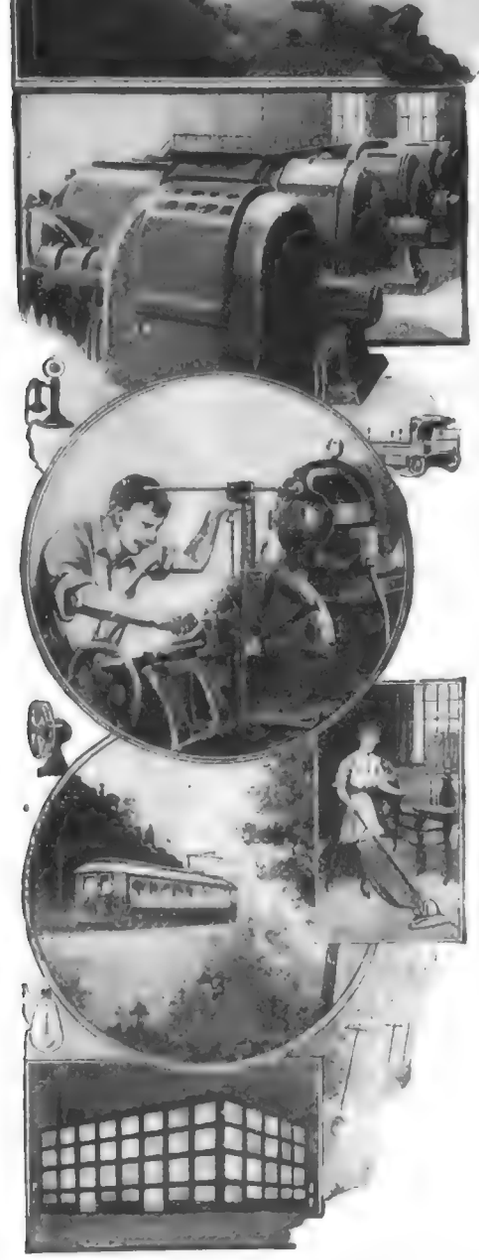

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Volume XI
Whole No. 131

Science and Invention

MARCH
1924
No. 11

H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., ASSOCIATE EDITOR
Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" -- HUXLEY

New Radio Developments

By H. GERNSBACK

THE Editor's mail, almost daily, contains letters from readers who want to be kept informed on various topics of radio. One of the most frequent questions is what the Editor thinks of the future of radio.

He has expressed himself at various times in both SCIENCE AND INVENTION and RADIO NEWS as to this phase, and he can only reiterate his past remarks, amplified by a few up-to-date ones, plus a few safe predictions.

I BELIEVE
¶ THAT within 5 years every house will have its Radio.

It is figured that there are about 2,500,000 radio outfits in operation now throughout the country. Considering the population of our country, this is a small percentage, especially if we compare radio to the phonograph and the automobile. Ultimately, there will be between 20,000,000 and 30,000,000 radio outfits in the United States. In other words, at the present time, we have no more than scratched the surface. Moreover, as with the phonograph and the automobile, the styles change rapidly. Just as it is uncommon to see a car five or six years old, so it is uncommon in radio to see an outfit more than a year or two old. New and improved models are being put out every day, and, of course, they continually improve. And this development is toward the simplification of apparatus. Several years ago, radio outfits were equipped with dozens of knobs and a quantity of dials. Gradually, the single control is forging to the foreground. The average man, who is not an expert in radio, does not wish to bother with a quantity of knobs and dials any more than the phonograph owner would wish to concern himself with the internal mechanism of the machine in order to get his music. After a while we will even get away entirely from the knobs and dials. *The knob idea is all wrong, anyway.* The writer is now experimenting with a set that has neither knob nor dial. It has just a series of jack openings and that is all. If you wish to get station "KYW" you plug into a jack provided for that purpose. If you wish to get station "WDAP," you insert your plug into that jack. Nor is such a set designed for long distance work. There are more people interested in local stations than there are DX (long distance) chasers. It is particularly for the lady of the house that such a set will be of great use. The man who wishes to get distance can make his selection from a dozen or more outfits for this particular purpose.

At the present time there is a slow swing from the telephone head set to the loud-speaker. Local dealers will still tell you that the proportion of head phones sold to loud-speakers is 5 to 2. But in another year or two, the proportion of the loud-speakers will probably be larger than that of telephone receivers. As circuits are getting better, the loud-speaker forges its way to the foreground, slowly but steadily. And by the way, the present loud-talker, as the writer has always maintained, is all wrong. Several laboratories are now busy developing loud-speakers, which have neither diaphragm nor horn, strange as the statement may sound. But just think that you can hear the sweet tones of a good violin throughout a big auditorium! No diaphragm or horn is used to accomplish this! This is the very principle that is being incorporated into the new loud-speakers which will make their appearance some time during the year. It is even predicted by the writer that the radio cabinet itself will talk! By that is meant that the entire wood portion of the cabinet will give out sounds, no horn being used at all.

I BELIEVE
¶ THAT the average scientist is in a class by himself for his narrow vision.

But radio will begin to get into its real strides as soon as our outfits will be equipped with Television apparatus. Recently in Washington the writer saw his own hand projected by radio, and he could see it move to and fro on a screen, the entire transmission being accomplished by radio. The practical adoption of this is much nearer than most people think. It would not be surprising to the writer if within two years all of our present radio outfits will be equipped with Television apparatus which will neither be cumbersome nor very expensive. A small ground glass plate, about six by seven inches, set into the top of the radio cabinet, with the rest of the apparatus behind it, is all that is required. Two years hence you will probably be sitting in your study and will be watching the progress of a baseball game as it is being played 500 miles away.

I BELIEVE
¶ THAT the U. S. Government should subsidize all meritorious inventors.

The mechanical applications of radio at a distance, called radio telemechanics, have as yet not been touched upon, at least, not in a practical way. It is possible today to write a check in New York and have the identical signature traced on a check by pen and ink at the same instant in Chicago. It is possible to typewrite a letter on a radio typewriter in New York and have the same letter radio-typed on a receiving machine in Chicago at the same instant.

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Trans-Polar Mail Routes Soon

Arctic Explorer Stefansson Predicts New Air Routes Across Pole.

By H. WINFIELD SECOR

That the North Polar region will be as well covered with aerial mail routes within ten years as the Atlantic Ocean is covered with steamship routes today is the opinion of Vilhjalmur Stefansson, famous Arctic explorer. In commenting on the contemplated trip of the giant Navy dirigible, Shenandoah, across the North Pole which is scheduled by the Navy Department to take place early next summer, the explorer said that there was no reason why the shorter distances between certain points which may be gained by taking advantage of air routes over the North Pole should not be realized with the present development of air navigating devices. In the accompanying illustration is graphically shown the great saving in distance and time that may be made by the use of these air routes over the pole. These courses simply take advantage of the saving effected by sailing the earth's surface on a Great Circle, a course long followed by mariners whenever possible. Officials of the Aeronautical Division of the Navy have already contemplated making a base for the giant dirigible at or near Nome, Alaska. They also stated that it would be a small matter to construct mooring masts similar to the ones now used at various landing fields throughout the country on an Arctic course. All the opinions delivered seem to point to the fact that the rigors of such a journey made in a lighter-than-air machine would be less than those encountered by airmen during the war when they were forced to fly at great heights. It was said that the Shenandoah had already been put through tests that proved conclusively that the Arctic trip would present no great hazards for such a craft. A cross-section of the ship showing the accommodation space available and the mechanical construction is seen in the insert.

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LONDON-NOME BY AIR 4,290 MI. = 3 DAYS
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NOME ALASKA
CANADA
SEATTLE
PORTLAND
NEW YORK
PACIFIC OCEAN
ALL WATER ROUTE PORTLAND ORE. TO CALCUTTA INDIA 10,031 MI. = 27 DAYS
STOCKHOLM TO SAN FRANCISCO ALL WATER ROUTE 10,250 MI. = 28 DAYS
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Parting of Red Sea Filmed

Spectacle Shows Israelites Passing Through Sea On Dry Land.

WHAT YOU SEE IN THE FILM
HOW IT WAS DONE
ISRAELITES ON SHORE OF RED SEA, WATCHING THE APPROACHING PHARAOH, RAMESES II WITH 600 CHARIOTS
1
MOSES RAISES HAND AND RAGING STORM STRIKES SEA: WATERS SINK AND DRY PATH APPEARS BETWEEN WALLS OF WATER 30 FEET HIGH
1A
THIN STEEL TEMPLATE IS CUT, BLOCKING OUT PORTION OF FILM MARKED "X": THEN SHOT IS TAKEN AT SEA SHORE OF STORMY SKY AND WAVES
WHAT YOU SEE IN FILM
2
SEMI-CLOSE-UP OF ISRAELITES WALKING THROUGH PATH: THIS TAKES SEVERAL MINUTES, DURING WHICH SKY, WAVES AND WATER WALLS ARE CLEARLY IN RAGING MOTION.
HOW IT WAS DONE: (APPROACHING PEOPLE ARE SUPERIMPOSED ON "X" SECTION OF PART OF NEGATIVE TAKEN AT 1E)
3
THEY WADE ASHORE ON FAR SIDE OF SEA, AND, LOOKING BACKWARD, DISCOVER EGYPTIANS PURSUING THEM THROUGH PATH
1B
"Y" IS THEN COVERED AND "X" IS SHOT FROM CLOSE-UP LOCATION AS SHOWN BELOW:
TANK
TANK
1C
THIS SCENE TAKEN WITH FILM RUNNING BACKWARD SO THAT WATER APPEARS TO RUN BACK UP WALLS, GIVING EFFECT OF PATH OPENING
4
NEXT SCENE SHOWS EGYPTIANS WITHELD FROM FOLLOWING BY SHEET OF FLAME ACROSS THEIR PATH
JETS OF FLAME 40 FEET HIGH FROM CONCEALED GASOLINE PIPE
SHORE
1D
AFTER WATERS HAVE RECEDED TO DOTTED LINE "Q" SPACE "Z" ON NEGATIVE IS SHOT AS BELOW
WATER SCREEN, IMITATING SEA WALL BACKGROUND
FLAME SUBSIDES AND EGYPTIANS DASH TO PATH THROUGH SEA THEN
5
5A
SHOT OF EGYPTIANS DASHING TOWARD CAMERA, SUPERIMPOSED ON THE "X" SECTION OF BALANCE OF FILM TAKEN AT 1E
5B
FADE-OUT OCCASIONALLY TO CLOSE-UP OF PHARAOH, DRENCHED WITH SPRAY, RACING THROUGH PATH
LIGHTS
OPERATOR OF LIGHT FLASHES
1E
GELATINOUS MINIATURE WALLS WITH LIGHTS FLASHING THROUGH THEM TO GIVE THE NECESSARY MOVEMENT TO THE APPARENT WALLS OF WATER
YOU SEE
TANK
TANK
DUMMY MEN AND CHARIOTS
6B
NEXT VIEW SHOWS TANK SCENE—THIS TIME CAMERA IS RUN CORRECTLY AND WATER FALLS ON DUMMIES
6
EGYPTIANS, AS IN 5A, DESTROYED BY HUGE WAVE
HOW DONE
6A
ORDINARY SEA WAVE SUPERIMPOSED ON NEGATIVE "5A" THEN
6C
DUMMIES PHOTOGRAPHED IN GLASS TANK THROUGH WATER

A monument to the science of movie photography is the recent Paramount production "The Ten Commandments" in which the old Bible story of the passage of the Israelites through the Red Sea on dry land is filmed in colors. Practically all of the work had to be done by double exposure and a large part by triple exposure. To obtain the parting of the waters, two large bodies of water from tanks (1C) were taken with the camera running backward. The path through the water with the Israelites walking along it was a piece of triple exposure work. After the waters were shown divided, a regular sea scene was taken with a portion of the film covered (1A). The exposed portion was then covered and the dummy walls (1E) were exposed on the second portion of the film. The film was then rewound and the third portion which had not been exposed in either of the two previous scenes was exposed for the scene of the Israelites walking over a piece of sandy beach. The net result is seen at 2, the picture as it appeared on the screen. After the fire curtain subsided (4) the Egyptians followed. Close-ups showing them passing after the Israelites were shown. Then a mighty wave passes over the top of the sea and Pharaoh and his hosts are drowned. For this effect, a huge wave on a regular sea was taken by the double exposure method in place of the scene at 1A. Then the scene changes to a close-up of the waters closing, taken with the tanks as at 1C, with the cameras running forward to get the waters coming together. Dummy horses, chariots and characters were put in the center where the waters met. Then a scene taken as at 6C shows the dummies floating through the water. The illusion of the picture is complete. All the scenes where double and triple exposures were used were taken at an apparent height of sixty feet above the characters, minimizing the differences in register that might appear. The movement of the picture at this point is so swift that the spectator has no time to watch for imperfections.

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How I Would Speak to Mars

By H. GERNSBACK
MEMBER AMERICAN PHYSICAL SOCIETY

SILVERED MIRROR
POWERFUL ARC
IRON ARMATURE
ELECTRO MAGNET
MICA VIBRATING MEMBRANE
AUDIO AMPLIFIER
CARRYING WIRE
MODULATED CURRENT
SIGNALLING WILL HAVE TO BE DONE SHORTLY AFTER NIGHTFALL - SHORTLY AFTER EARTH AND MARS HAVE PASSED OPPOSITION, SO THAT GLARE OF SUN WILL NOT INTERFERE
Fig A
MARS
SUN
EARTH
2 STEPS AUDION AMPLIFICATION ON IMPULSES REACHING PHOTOELECTRIC CELL

MANY schemes have been suggested in the past how to establish communication with the planet Mars, providing, of course, that it is inhabited by intelligent creatures—of which the writer has always been convinced. The idea of flashing light rays on and off by interrupting the light has always seemed a cumbersome method to the writer. There is a much simpler method to establish communication with Mars, which is not very costly and does not call for an outlay of billions of dollars and a tremendous amount of energy.

In the late 70's, Professor Alexander Graham Bell, inventor of the telephone, evolved the photophone as shown in Fig A. This shows the principle of sending articulate speech or music over a beam of light. A light beam having no inertia and no weight, it matters not how great the distance is over which such articulate speech or music can be sent. By slightly varying the light beam, it is possible to carry on a one-way conversation. Herr Ruhmer in Germany carried on conversation over a light beam for the maximum distance possible on earth, that is about 100 miles. Longer distances are not possible on earth due to the curvature of the planet, as light rays do not follow this curvature but shoot out into space.

There are many ways in which the voice can be superimposed on the rays of a searchlight. One way is shown to the right. Another, and probably a better way, is to modulate by means of a microphone, the current flowing in the powerful arc light carbons. The voice or music is first stepped up and then impressed upon the arc light. The writer figures that it does not require more than 1,000 of such arc lights to show on Mars, the same to be erected on some lofty mountain range. If these arc lights are disposed in a row, in a straight line, 10 abreast, in strings of 100, and separated by 500 feet, as shown in the top illustration, this would be sufficient to produce a faint spot of light which could be observed by Martians under favorable conditions. It would, of course, have to be night on earth for the experiment, while on Mars it should be about one hour or more after nightfall to obtain the best results. The diagram gives best position of the two planets. If an observer on Mars would then train his powerful super-telescope towards the earth, he would see on the darkened portion of the earth a very faint spot of light. If he were a good physicist, which no doubt he would be, he would attach a photo-electric or other light-sensitive cell in the focus of the telescope. This, connected to an audion amplifier, would bring in the sounds faithfully and clearly. See bottom illustration.

It is possible that even today the Martians are using such a system to signal to us, but so far our telescopes have not been developed sufficiently for us to see faint light spots on the darkened portion of Mars. If ever one of our astronomers sees them, it would be a good idea to try a photo-electric cell attached to a telescope, as shown on the right.

Several astronomy books make record of a peculiar flash of light that has been observed a number of times when the planet Mercury passed over the face of the sun. (Transit). There is a possibility if there are inhabitants on Mercury that they are trying to signal to us with some such means as outlined here.

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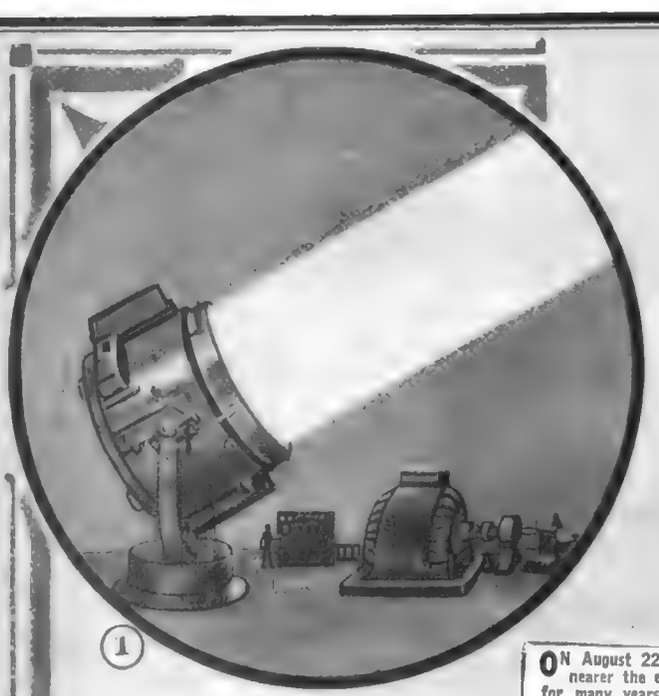
Can We Signal Mars?

Coming Opposition Raises Question

BY CHARLES T. DAHAMA



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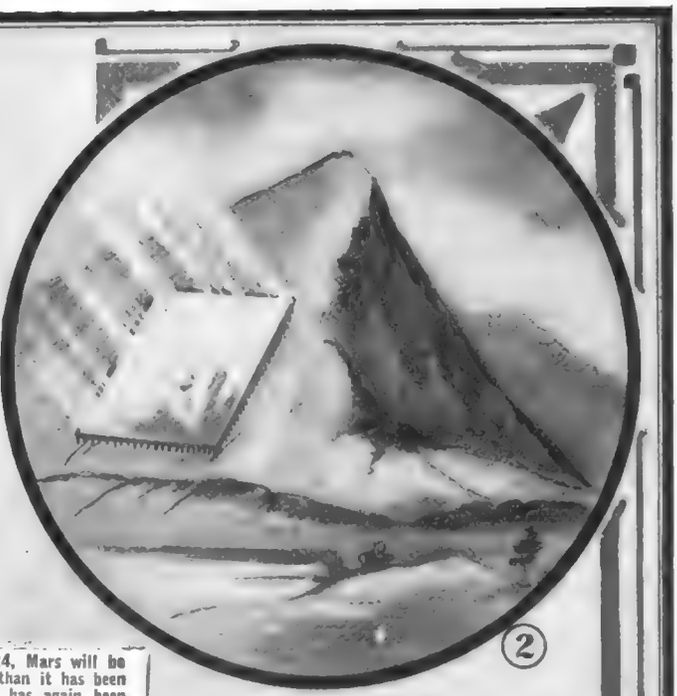

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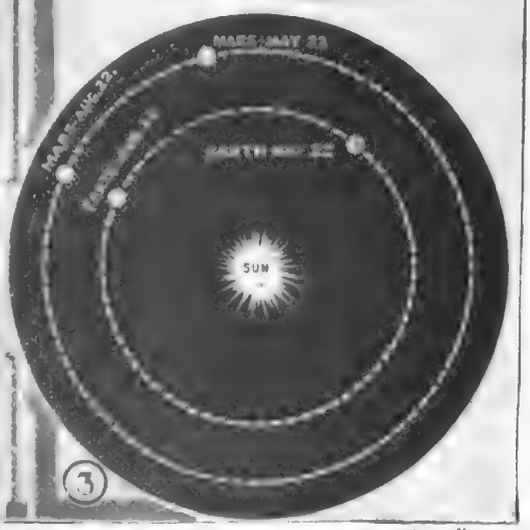
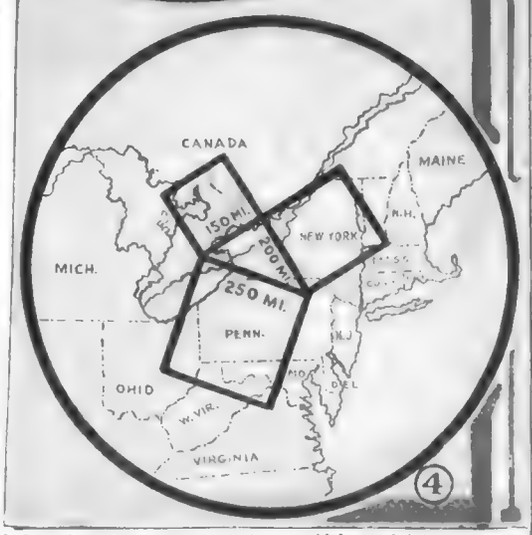


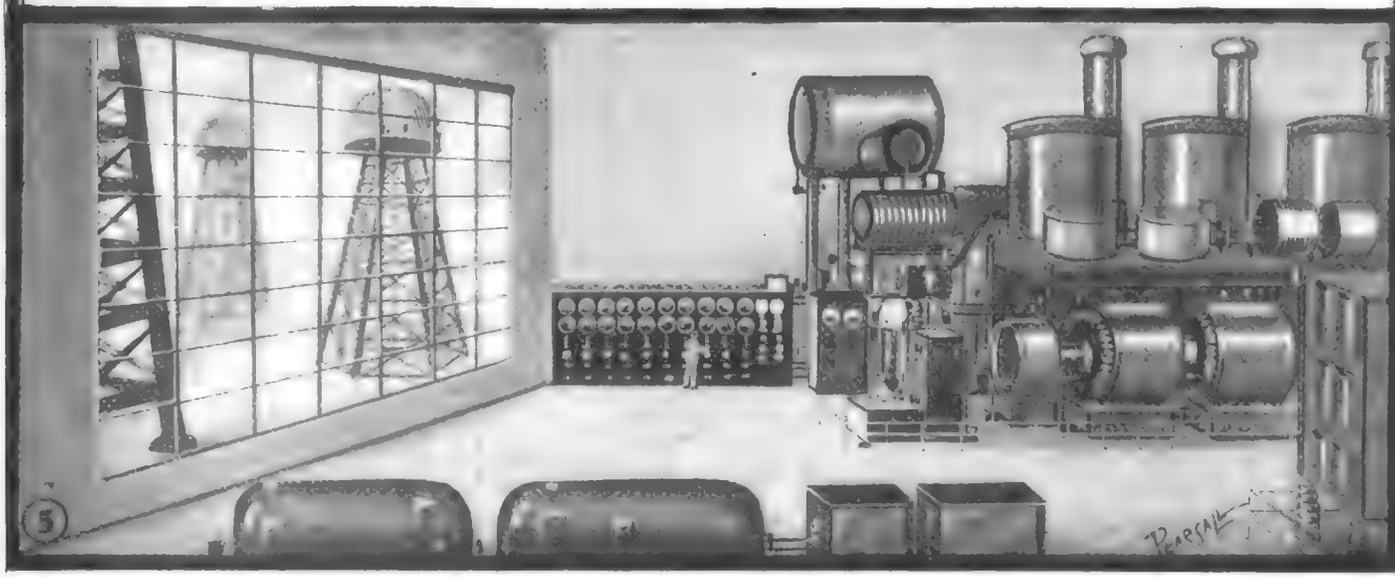
3

ON August 22, 1924, Mars will be nearer the earth than it has been for many years. It has again been suggested that we try to establish interplanetary communication. Recent newspaper articles have claimed that scientists will attempt to signal Mars at the same time by means of a huge mirror on the snow-covered sides of the Alps. (Fig. 2). Aside from the difficulty of getting such a mirror (to make a visible signal it would have to be half a mile in diameter) those sponsoring this scheme have forgotten, as may be seen from Fig. 3, that Mars is on the opposite side of the earth from the sun and that Mars and the sun, therefore, cannot be in the sky at the same time. Using a smaller mirror would be about like using a flashlight to get a better view of the moon. To make a signal just bright enough to be seen on Mars would require a searchlight of 50 trillion candle-power, equal to the combined light from a billion arcs. (Fig. 1.). Our most powerful wireless stations might be able to signal as far as the earth's circumference 25,000 miles. Mars, when nearest, is about a thousand times this distance. To reach there the sending station (Fig. 5) would have to make its signals a million times as intense. Huge forests indeed, ten miles wide and hundreds long would be needed to carry out this idea. It is the author's hope that these statistics will settle definitely the perennial question of signalling Mars.



4

With our largest telescopes, an object as large as ten miles across would look like a mere speck. It has been suggested that we plant trees in huge geometrical figures (Fig. 4) so that our Martian brothers may see that intelligent life exists here.



5

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Starting with the January issue, SCIENCE AND INVENTION is paying $1,000.00 or more each month of the year in prizes. Every article published in the regular news section will receive one of them.

(The departments have awards of their own which they will continue to give.)

Ideas are what the editors want. They must be told simply—so your mother or sister can understand them—in pictures and sketches. Be sure they are NEW and have something to do with science or invention. The editors want pictures and sketches—

88 monthly prizes will be given as follows:

FIRST PRIZE $100.00

2	PRIZES of	$50.00	each
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5	" "	20.00	"
10	" "	15.00	"
20	" "	10.00	"
10	" "	5.00	"
20	" "	2.00	"
10	" "	1.00	"

$12,000 or More in Gold

must have them—but ideas are wanted most of all.—And they will be handsomely paid for. The rules of the contest will be found on page 534 of the October issue. If you haven't a copy, one will be mailed you free on receipt of your name and address. It will give full details of the rules and hints on submitting articles. The closing date for all prize contributions will be the 15th of the month preceding date of issue, i.e., 15th of March for the May number; the 15th of April for the June number, etc.

WILL YOU BE OUR REPORTER?

IN Connection with our $12,000.00 prize contest announced herewith, it goes without saying that you will have to hustle to win a prize. The Editors do not wish to make it hard for you; quite the contrary. We want the pictures and want them badly. Herewith is reproduced our reporter's card. We shall be glad to send it to anyone who makes an application. By means of this card you will be able to secure entry into industrial plants, business houses, motion picture studios, steamships, mines, etc. This card will prove an open sesame to you in many instances. Each card is numbered and only one is given to a correspondent. A postal card from you and a request for this reporter's card is all that is necessary for obtaining one. It will be sent you by return mail. Address Field Editor, SCIENCE AND INVENTION, 53 Park Place, New York City.

REPORTER

Science and Invention — CORRESPONDENT REPORTER'S IDENTIFICATION

NO. 999

THE BEARER OF THIS CARD John Doe IS AN AUTHORIZED CORRESPONDENT-REPORTER OF SCIENCE and INVENTION MAGAZINE THE PUBLISHERS OF SCIENCE AND INVENTION WILL APPRECIATE ANY COURTESY EXTENDED THEIR REPRESENTATIVE.

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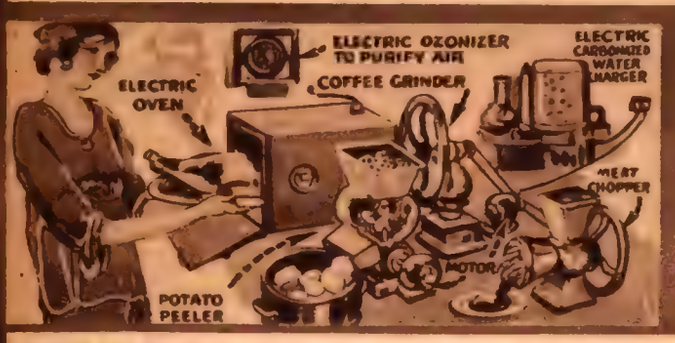
Mechanical Servants

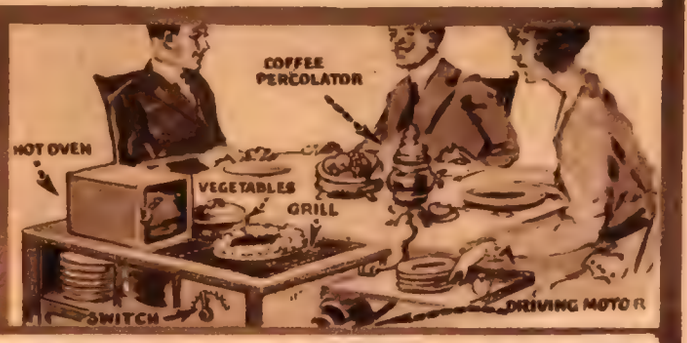
French Ideas in Circumventing the Servant Problem.

THE servant problem seems to be closer to the French than it is to the Americans. At least, that would appear to be the case after examining the recent Exhibition of Household Arts held in Paris. Above is shown one of the most ingenious devices that appeared in the exhibition—a mechanical shoe polisher. It is run by an electric motor and does the job just as well as the bootblack.

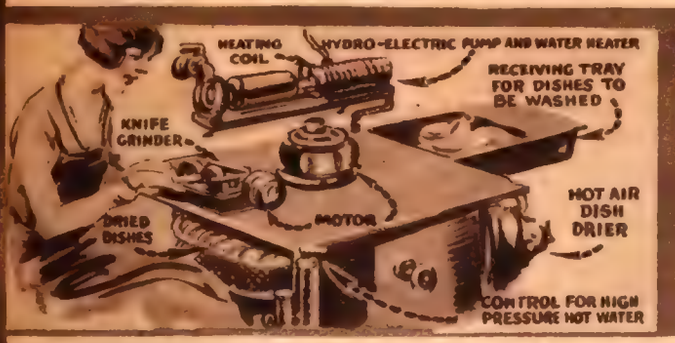
The vacuum cleaner has come more or less into general use as a cleaner for the house. As time passes it is becoming more and more important as the different attachments find handy uses. Two of its first cousins, however, an electrical floor scrubber and waxer, are little known, though they fill a long felt want. Two types of these pieces of apparatus are shown in the above illustration.



That the housewife can take all the drudgery out of kitchen work with the aid of a few electrical and mechanical appliances is shown here. There is one for each of the small, annoying jobs that fall to the daily lot of the housekeeper. A self-regulating electric oven, a potato peeler, meat chopper, air purifier and water carbonator are a few of the pieces of apparatus seen at the show.



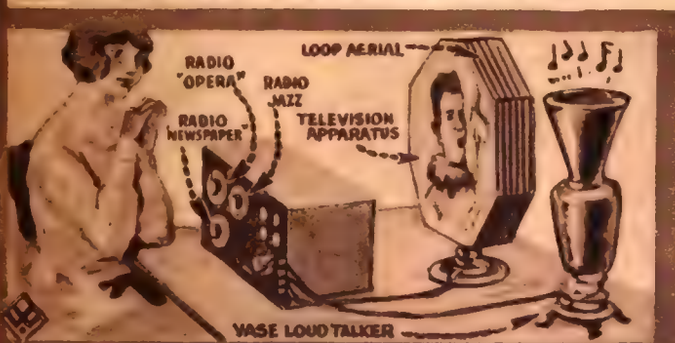
For the family that is too small to need a maid, many of the useless steps that cause the wife so many annoyances at meal time are circumvented by this simple arrangement. The serving table, shown above, is a kitchen in miniature. It has an electrical connection and contains an oven for keeping the dishes already cooked, warm, a grill for cooking, an electric percolator, etc.



Almost every housewife will worship the inventor of this electric dish washer. It is so perfected that it is only necessary to stack all table ware, including the silver, in a rack, set them into the machine and manipulate three adjustments when—lo—they come out dried and polished. There is no necessity to depend on the janitor for hot water; the machine heats its own water.

TELEGRAPHONE
RECORDS ON STEEL WIRE
TO RIGHT
IF OFFICE IS CLOSED VISITOR RECORDS HIS MESSAGE ON TELEGRAPHONE
IF OFFICE IS OPEN VISITOR IS INSTRUCTED BY ILLUMINATED SIGNS

There are many businesses where the owner finds it necessary to spend a large part of his time out of his office and where the number of callers does not warrant keeping an assistant to answer such calls. The telegraphone settles his problem. The visitor, on finding the man out, simply pushes a button and speaks his message into a mouthpiece.



Of course, no home is complete without its entertainment, and, thanks to the engineers, it is no longer necessary to buy tickets and fuss with taxi drivers to get it. Simply go to the radio set, select the type of entertainment you desire, and the scientific genii renders it. The music issues forth from the loud speaker and the television of tomorrow will show us the image of the performer.

And here the sting is taken out of sleeping out of doors in winter. After disrobing it is no longer necessary to walk across the cold floor to the sleeping porch and then to spend several shivery minutes while the bed warms. Retire in a warm room, get into a warm bed, press the button, ah—the bed rolls to a pair of folding doors, pushes them open and rolls out into the night.

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The Man On the Meteor

By RAY CUMMINGS

Part III

SYNOPSIS OF "MAN ON THE METEOR"

PARTS I and II

WITH no memory of past events, a young man suddenly comes to his senses on a meteor which is part of one of the rings of Saturn. He finds that, due to the small size of the meteor, his body weighs very little and he experiences great difficulty in walking. Being hungry and thirsty, he looks around for nourishment and finds the mouth of a cave. As he looks towards the cave a girl comes into view. At the same time she catches sight of him. Suddenly she leaps into the air with a motion similar to that of a swimmer in water and sails gracefully away.

The city was, I should estimate, of roughly circular form some quarter of a mile long and nearly as broad. Like a huge, low cylinder standing on end. It was a fibrous city of growing sea-vegetation! Huge stalks planted like a thick forest of trees grew straight upward, sustained in an upright position by their tremendous air-bladders.

The young man, who calls himself Nemo, enters the cave and after traversing some little distance finds it to be illuminated by the phosphorescence of the rocks forming its walls.

Lying down on the girl's couch, he soon is lost in slumber. Upon awakening he sees her standing nearby and starts toward her, whereupon she leaps into the air and "swims" to a nearby ledge. He pursues her, but she constantly evades him. Soon, exhausted, he lies down once more and sleeps. He is awakened by the young lady stroking his hair. They become friends. She teaches him how to jump thousands of feet into the air and return, using a peculiar swimming motion. Soon after, they enter the cave, and the girl catches and kills a huge lizard-like creature. They cook and eat the flesh of the animal. Nona, as he has named the girl, watches him intently. Nona comes over to his side. For a moment they are silent, Nemo's heart racing madly. Suddenly, he takes her into his arms.

Thus Nemo has found his habitable world and his mate beyond which the legitimate needs of man do not go.

The problem of finding sufficient food now becomes paramount in the life of Nona and Nemo. One day upon returning to the cave Nona shows Nemo several mollusks which are very good to eat. She then takes him to the place where she found them to gather some more. They wade into the stream and follow it into its cavern. The water gets deeper and deeper and finally Nemo sees that Nona's head is completely engulfed. Soon his head goes under water and he feels the liquid rush into his lungs. However, by violent effort he is able to breathe; the feat finally becomes easier. He finds that the water, being so highly aerated, readily supplies his blood with the necessary oxygen to sustain life. They come to a bed of shell-fish, collect enough for their needs and go back to their home in the cave. They start a fire, cook their supper and retire.

In the middle of the night they awake to find their entire cavern in flames. The rock, being of a combustible nature, has become ignited from their cooking fire. They dash toward the mouth of the cave and out to the surface of the meteor. Thus robbed of their home they "swim" through the air to the opposite side of the planet. Here they make their home beside a large stream at a point where it enters a low hill. Soon smoke and obnoxious fumes from the conflagration drift over to their side of the small meteor and make things very uncomfortable. Nemo is suddenly seized with an idea and taking Nona with him they plunge into the water, which is approximately 30 feet deep, and follow the bed of the stream into the mountain. Soon they find food and devour it, still under water.

At this point they see coming toward them a party of ten people, four men and six women, who are somewhat human in form, but have four arms like the tentacles of an octopus. Nemo and Nona are captured and tied by them. A large vehicle is seen coming along the bed of the stream and the Marinoids, as Nemo calls his capturers, prostrate themselves. Nemo does not follow suit and the occupant of the vehicle throws a spear at him. He is struck and falls senseless.

I still held his ankle, and he did not try to kick himself loose. He seemed to be manoeuvering for something. He was swimming forcibly downward now, using his arms but leaving his legs limp. It drew our bodies through the water in a single straight line, like one boat towing another.

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I TAKE up my narrative at a point some four or maybe five months (as you here on earth measure time) after Nona and I entered the world of the Marinoids. The human memory retains only high spots clearly; and those four or five months held nothing which now impresses itself strongly upon me.

Then came the great event for me and Nona that I could never forget. You shall hear of it in a moment; and you shall hear how it was followed by a series of adventures the memory of which even now makes me thrill as I thrilled then with the hot blood of youth.

First you will want a brief description of these Marinoids with whom we took up our life—a sketch of what befell us during those four or five months.

You will recall that I had been knocked unconscious by a blow on the head. When I recovered, the ruler of that world had passed on his way and our captors were again dragging us forward.

We came presently to a city. A city, you say! A city under water! Why not? By a city I mean a closely-knit collection of human dwellings where a large number of people lived close together. Is that not a city?

This one was the capital of the Marinoid world. They called it Rax—a brusk, somewhat guttural monosyllable which I write with those three letters.

There we took up our abode with the leader of this Marinoid party which had captured us. There we learned the Marinoid language, and became a part of the Marinoid civilization—with friends and enemies, hopes, fears and despairs.

As I have already told you, our own spoken language was no more than at its beginning. We turned to that of the Marinoids readily; and within a few months it was to all intents and purposes native to us. That you may understand this point, I remind you again that our intellects were matured but unused. We learned like precocious children.

More than that, this contact with other beings with minds like our own brought us rapidly up from the primitive mental state in which I have previously pictured us. We learned that one great trait of civilization—deceit. But I thank my Creator there still remained in us a simplicity— a directness of thought and action which somehow seems to lessen in so-called civilization.

THE MODE OF LIFE

You will picture us then—Nona and me—as we were at the end of these months with the Marinoids. We lived in a dwelling near the bottom and outer edge of the city of Rax. The bottom of the city! A strange term! Let me explain.

Nona selected a two-story house, at the intersection of a horizontal with a vertical street. It had one room upstairs, and two downstairs—small rooms, you would call them, no more than fifteen feet cube. But the house had a little horizontal balcony upstairs. On it Nona could lie and watch the people passing.

Here on Earth you live in a world you call three dimensions—length, breadth and thickness. By that, you mean your bodies, and all material objects comprise three dimensions. Perfectly right. But you live *on the surface* of a globe. In general—with exceptions of course—your actions take place in but two dimensions. Your birds move in three dimensions more than you do. And your fishes.

Fishes! There you see my point! In the Marinoid world of water, to move vertically came as naturally as the horizontal movement. Hence, I say the bottom of the city, for Rax had a vertical dimension almost as great as either of its others.

The city was, I should estimate, of roughly circular form some quarter of a mile long and nearly as broad. Like a huge, low cylinder standing on end.

It was a fibrous city of growing sea-vegetation! Huge stalks planted like a thick forest of trees in the sandy ooze of the water-bottom, grew straight upward a thousand feet or more. Broad, leaf-like branches spread from them at the top, sustained in an upright position by air-bladders.

These upright stalks were the vertical girders upon which the fabric of the city was built. For eight hundred feet up they were pruned of their branches. Parasite growing vines had been guided laterally to connect the vertical stalks. And upon these, other rope-like vegetation was woven. The result was a series of tiers some twenty feet apart—one above the other—forty of them from top to bottom of the city.

The tiers were further cut up into segments which served as houses. I shall describe one in detail presently—the one they gave Nona and me at the time our great event took place.

Throughout the city there were both vertical and horizontal streets at intervals—up and down and along which the inhabitants swam or drifted. And occasionally there was cubical open space—a sort of three-dimensional park. One of these, the largest, occupied the exact center of the city, with the ruler's home contiguous to it.

Have I made myself clear? The fabric of this entire city—the very walls and rooms of its honeycombed houses—was living, growing vegetation of the sea. It grew rapidly. It was easily trained to grow in desired directions. A third of a man's lifetime, no more, would grow such a city as this.

One species of vegetation? No, there seemed a hundred— nd each one of them had its specific use a l adaptability. It was curious stuff. You have marine vegetation in your great oceans of Earth. You may conceive what this was like. Tough, smooth, somewhat slimy main stalks. But porous—

(*Continued on page* 1171)

One of his feet touched one of mine; and simultaneously his fingers struck my head. For a brief instant I was conscious that his touch seemed to burn. A tingling shock ran through me. Then, inert and unconscious, my stiffened body sank slowly to the bottom of the arena.

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Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

There was no longer any possible doubt. Percy rubbed his eyes again and again, but there could be no questioning of the fact that this was a genuine mermaid. The upper part of the creature was the fine'y molded body of a beautiful young woman, but instead of legs, she had an evident tail.

No. 27
The Secret of the Mermaid

AUTHOR'S NOTE.—For many years our surgeons have been able to perform astonishing feats in grafting one part of the body upon another, and even one animal upon another, a live rat having been grafted upon the back of a cat, the pair living in harmony together. Of recent years still more wonderful feats have been accomplished. Doctor Alexis Carrel, of the Rockefeller Institute of Research having succeeded in keeping detached portions of the body alive for months in suitable solutions. Doctor Carrel was also very successful in transplanting organs from one animal to another. He even received the Nobel prize for his method of suturing the blood-vessels of the parts together.

It is therefore safe to say that operations, such as the one I have mentioned in this story, will at no distant date, be matters of everyday routine; and will seem as commonplace as the fact that we can now converse by telephone with friends hundreds of miles away.

PROLOGUE

THE circus performance was at its height. The trained seals had performed their wonderful feats of catching and balancing balls, and now it was the turn of the high diver, Miss Olla Podrida, as she was called on the bills. Her real name was Olive Bird, but Olive had been changed to Olla, and "Olla Podrida"—literally the Spanish for "A little of everything"—had struck the manager as making an attractive stage-name for the young girl.

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"Fetch me the man who owns the trained seals!" cried Doctor Hackensaw to his servant. "And bring with you the largest seal. The only hope of saving the girl's life lies in my having one of the seals at once! I must buy the animal from the owner at any price!"

Half an hour later an operation was performed on the unconscious girl—an operation the like of which had never before been attempted in scientific annals.

I

Mr. Percy Fitzmaurice was taking a stroll in the country one fine spring afternoon, and was enjoying the odors of the flowers and the songs of the birds, when suddenly, far sweeter than the song of any bird, came the tones of a soprano voice, singing divinely. Percy was enchanted. He was a lover of music, and there was something wonderfully clear and melodious in the tones. Evidently it was the voice of some young girl whose blood had been sent coursing through her veins by the advent of spring, for the song of a young girl, like that of the birds, is nothing but a love-call to some unknown mate.

"If I were living in the old days," thought Percy, "I would feel sure that this was the song of a siren, and was intended to lead me to my destruction. Here in New Jersey, however, in the Twentieth Century, no such explanation is possible. I'm bound, however, to have a peep at that young lady, even if I die for it."

It was not an easy matter, however, to get a peep, for the road was bordered by a long high wall that enclosed some wealthy man's estate. And the voice came from behind the wall.

"This place must belong to some exclusive millionaire," was Percy's inward comment. "It must be his daughter who is singing. Well, perhaps I'll be Prince Charming and win the fair maid and half her father's kingdom."

SEEKING THE VOICE

Percy glanced up and down the road, and chanced to spy a painter's ladder standing against a barn not far distant. Without asking for leave, the adventurous young man grabbed the ladder, scaled the wall, and then placing the ladder on the opposite side, climbed down into the private grounds. This part of the enclosure was very wild, many trees and shrubs forming a dense wood. Into this thicket Percy cautiously advanced in the direction of the voice, and soon came within sight of a small lake. But what was his astonishment to behold, in the middle of the lake, a beautiful young lady of about eighteen, swimming about gracefully in the water, but occasionally pausing with her breast and arms well out of the water and her long hair flowing loose about her shoulders. It didn't seem possible that a human girl could remain so far out of the water, and again Percy found himself involuntarily thinking of the sirens and the mermaids of by-gone days. And to add to this belief, every once in a while, he would perceive what certainly looked like a mermaid's tail thrashing up out of the water.

In silent wonderment Percy gazed, and then all his doubts were set at rest. The creature swam to a rock by the side of the lake and clambered out in full sight, only ten yards away from the spot where the young man stood. And once more from her throat trilled forth the wonderful melody that had so entranced the young man.

There was no longer any possible doubt. Percy rubbed his eyes again and again, but there could be no questioning of the fact that this was a genuine mermaid. The upper part of the creature was the finely moulded body of a beautiful young woman, but instead of legs, she had an evident tail—a tail exactly resembling that of a seal!

Percy stood riveted to the spot until the song began, and then forgetting everything, he came forward to the border of the lake.

MYSTERY

But at sight of him, the girl uttered a wild shriek and dived down into the water below. Percy rushed to the spot and looked down into the clear depths, but no sign of the creature could he see. She had vanished mysteriously, and, though he waited an hour, not a trace of her could he find.

As dusk was coming on, he unwillingly climbed the wall again and returned to his hotel. He said nothing of his adventure, but at table that evening he enquired of Pep Perkins, who happened to be staying at the same hotel, who the owner of the villa was.

"Oh, that?" cried Pep. "Why, that's old Doc. Hackensaw's place. The country people, all around here, are afraid to go anywhere near that stone wall. They tell all kinds of queer stories about the mysteries to be found on the doctor's place. But he's a good friend of mine, and I know he wouldn't harm a fly."

"Do you really know him?" cried Percy eagerly. "Could you get me an introduction to him?"

"Know him? Well, I should smile! The

(*Continued on page* 1166)

The young man lost no time. He grabbed her in his arms, and then to his surprise, he realized that this was no ordinary girl—it was the mermaid whom he had seen in the pond. Wild with delight, Percy carried her to his own car and then started off at full speed to Doctor Hackensaw's grounds.

Doctor Hackensaw led the way and Percy obediently followed. Pen after pen of monstrosities were exhibited, freaks such as a circus would have given a fortune to possess. Among other things was an animal with the horns of a cow, the head of a horse, the body of an ostrich, and the legs and arms of a monkey, while the tail was a snake's body without the head. To enumerate the creatures would be impossible. Large and small animals were there, vertebrates and invertebrates.

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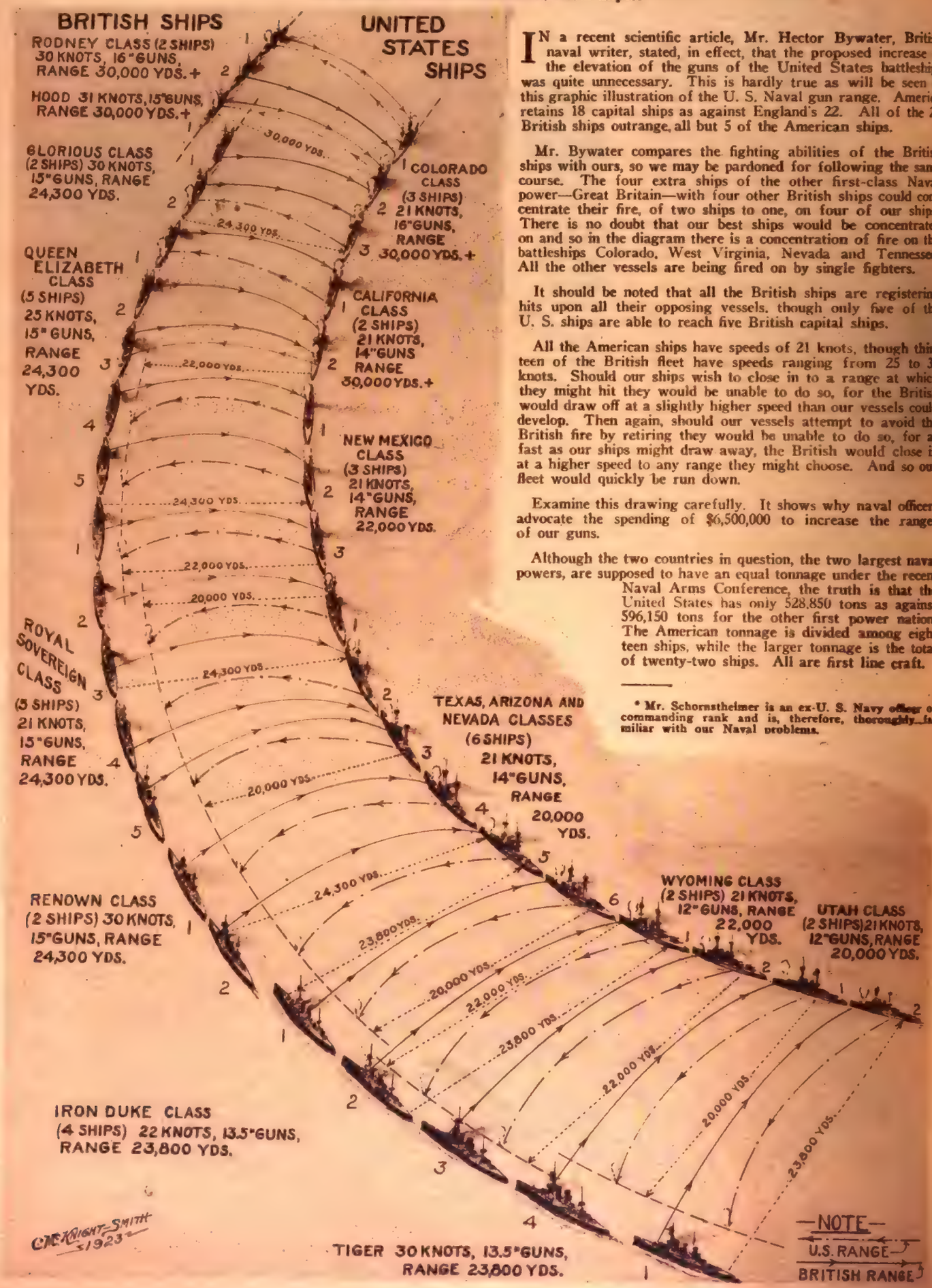
U. S. Versus British Gun Range

By GRASER SCHORNSTHEIMER, Naval Expert*


BRITISH SHIPS
UNITED STATES SHIPS
RODNEY CLASS (2 SHIPS) 30 KNOTS, 16"GUNS, RANGE 30,000 YDS.+
HOOD 31 KNOTS, 15"GUNS, RANGE 30,000 YDS.+
GLORIOUS CLASS (2 SHIPS) 30 KNOTS, 15"GUNS, RANGE 24,300 YDS.
QUEEN ELIZABETH CLASS (5 SHIPS) 25 KNOTS, 15" GUNS, RANGE 24,300 YDS.
ROYAL SOVEREIGN CLASS (5 SHIPS) 21 KNOTS, 15"GUNS, RANGE 24,300 YDS.
RENOWN CLASS (2 SHIPS) 30 KNOTS, 15"GUNS, RANGE 24,300 YDS.
IRON DUKE CLASS (4 SHIPS) 22 KNOTS, 13.5"GUNS, RANGE 23,800 YDS.
TIGER 30 KNOTS, 13.5"GUNS, RANGE 23,800 YDS.
COLORADO CLASS (3 SHIPS) 21 KNOTS, 16"GUNS, RANGE 30,000 YDS.+
CALIFORNIA CLASS (2 SHIPS) 21 KNOTS, 14"GUNS RANGE 30,000 YDS.+
NEW MEXICO CLASS (3 SHIPS) 21 KNOTS, 14"GUNS, RANGE 22,000 YDS.
TEXAS, ARIZONA AND NEVADA CLASSES (6 SHIPS) 21 KNOTS, 14"GUNS, RANGE 20,000 YDS.
WYOMING CLASS (2 SHIPS) 21 KNOTS, 12"GUNS, RANGE 22,000 YDS.
UTAH CLASS (2 SHIPS) 21 KNOTS, 12"GUNS, RANGE 20,000 YDS.
30,000 YDS.
24,300 YDS.
22,000 YDS.
20,000 YDS.
23,800 YDS.
C.M. KNIGHT-SMITH 1923
—NOTE—
U.S. RANGE
BRITISH RANGE

IN a recent scientific article, Mr. Hector Bywater, British naval writer, stated, in effect, that the proposed increase in the elevation of the guns of the United States battleships was quite unnecessary. This is hardly true as will be seen in this graphic illustration of the U. S. Naval gun range. America retains 18 capital ships as against England's 22. All of the 22 British ships outrange, all but 5 of the American ships.

Mr. Bywater compares the fighting abilities of the British ships with ours, so we may be pardoned for following the same course. The four extra ships of the other first-class Naval power—Great Britain—with four other British ships could concentrate their fire, of two ships to one, on four of our ships. There is no doubt that our best ships would be concentrated on and so in the diagram there is a concentration of fire on the battleships Colorado, West Virginia, Nevada and Tennessee. All the other vessels are being fired on by single fighters.

It should be noted that all the British ships are registering hits upon all their opposing vessels, though only five of the U. S. ships are able to reach five British capital ships.

All the American ships have speeds of 21 knots, though thirteen of the British fleet have speeds ranging from 25 to 33 knots. Should our ships wish to close in to a range at which they might hit they would be unable to do so, for the British would draw off at a slightly higher speed than our vessels could develop. Then again, should our vessels attempt to avoid the British fire by retiring they would be unable to do so, for as fast as our ships might draw away, the British would close in at a higher speed to any range they might choose. And so our fleet would quickly be run down.

Examine this drawing carefully. It shows why naval officers advocate the spending of $6,500,000 to increase the ranges of our guns.

Although the two countries in question, the two largest naval powers, are supposed to have an equal tonnage under the recent Naval Arms Conference, the truth is that the United States has only 528,850 tons as against 596,150 tons for the other first power nation. The American tonnage is divided among eighteen ships, while the larger tonnage is the total of twenty-two ships. All are first line craft.

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* Mr. Schornstheimer is an ex-U. S. Navy officer of commanding rank and is, therefore, thoroughly familiar with our Naval problems.

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I TAKE up my narrative at a point some four or maybe five months (as you here on earth measure time) after Nona and I entered the world of the Marinoids. The human memory retains only high spots clearly; and those four or five months held nothing which now impresses itself strongly upon me.

Then came the great event for me and Nona that I could never forget. You shall hear of it in a moment; and you shall hear how it was followed by a series of adventures the memory of which even now makes me thrill as I thrilled then with the hot blood of youth.

First you will want a brief description of these Marinoids with whom we took up our life—a sketch of what befell us during those four or five months.

You will recall that I had been knocked unconscious by a blow on the head. When I recovered, the ruler of that world had passed on his way and our captors were again dragging us forward.

We came presently to a city. A city, you say! A city under water! Why not? By a city I mean a closely-knit collection of human dwellings where a large number of people lived close together. Is that not a city?

This one was the capital of the Marinoid world. They called it Rax—a brusk, somewhat guttural monosyllable which I write with those three letters.

There we took up our abode with the leader of this Marinoid party which had captured us. There we learned the Marinoid language, and became a part of the Marinoid civilization—with friends and enemies, hopes, fears and despairs.

As I have already told you, our own spoken language was no more than at its beginning. We turned to that of the Marinoids readily; and within a few months it was to all intents and purposes native to us. That you may understand this point, I remind you again that our intellects were matured but unused. We learned like precocious children.

More than that, this contact with other beings with minds like our own brought us rapidly up from the primitive mental state in which I have previously pictured us. We learned that one great trait of civilization—deceit. But I thank my Creator there still remained in us a simplicity— a directness of thought and action which somehow seems to lessen in so-called civilization.

THE MODE OF LIFE

You will picture us then—Nona and me—as we were at the end of these months with the Marinoids. We lived in a dwelling near the bottom and outer edge of the city of Rax. The bottom of the city! A strange term! Let me explain.

Nona selected a two-story house, at the intersection of a horizontal with a vertical street. It had one room upstairs, and two downstairs—small rooms, you would call them, no more than fifteen feet cube. But the house had a little horizontal balcony upstairs. On it Nona could lie and watch the people passing.

Here on Earth you live in a world you call three dimensions—length, breadth and thickness. By that, you mean your bodies, and all material objects comprise three dimensions. Perfectly right. But you live *on the surface* of a globe. In general—with exceptions of course—your actions take place in but two dimensions. Your birds move in three dimensions more than you do. And your fishes.

Fishes! There you see my point! In the Marinoid world of water, to move vertically came as naturally as the horizontal movement. Hence, I say the bottom of the city, for Rax had a vertical dimension almost as great as either of its others.

The city was, I should estimate, of roughly circular form some quarter of a mile long and nearly as broad. Like a huge, low cylinder standing on end.

It was a fibrous city of growing sea-vegetation! Huge stalks planted like a thick forest of trees in the sandy ooze of the water-bottom, grew straight upward a thousand feet or more. Broad, leaf-like branches spread from them at the top, sustained in an upright position by air-bladders.

These upright stalks were the vertical girders upon which the fabric of the city was built. For eight hundred feet up they were pruned of their branches. Parasite growing vines had been guided laterally to connect the vertical stalks. And upon these, other rope-like vegetation was woven. The result was a series of tiers some twenty feet apart—one above the other—forty of them from top to bottom of the city.

The tiers were further cut up into segments which served as houses. I shall describe one in detail presently—the one they gave Nona and me at the time our great event took place.

Throughout the city there were both vertical and horizontal streets at intervals—up and down and along which the inhabitants swam or drifted. And occasionally there was cubical open space—a sort of three-dimensional park. One of these, the largest, occupied the exact center of the city, with the ruler's home contiguous to it.

Have I made myself clear? The fabric of this entire city—the very walls and rooms of its honeycombed houses—was living, growing vegetation of the sea. It grew rapidly. It was easily trained to grow in desired directions. A third of a man's lifetime, no more, would grow such a city as this.

One species of vegetation? No, there seemed a hundred— nd each one of them had its specific use a l adaptability. It was curious stuff. You have marine vegetation in your great oceans of Earth. You may conceive what this was like. Tough, smooth, somewhat slimy main stalks. But porous—

(*Continued on page* 1171)

One of his feet touched one of mine; and simultaneously his fingers struck my head. 'For a brief instant I was conscious that his touch seemed to burn. A tingling shock ran through me. Then, inert and unconscious, my stiffened body sank slowly to the bottom of the arena.

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Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

There was no longer any possible doubt. Percy rubbed his eyes again and again, but there could be no questioning of the fact that this was a genuine mermaid. The upper part of the creature was the finely molded body of a beautiful young woman, but instead of legs, she had an evident tail.

No. 27
The Secret of the Mermaid

AUTHOR'S NOTE.—*For many years our surgeons have been able to perform astonishing feats in grafting one part of the body upon another, and even one animal upon another, a live rat having been grafted upon the back of a cat, the pair living in harmony together. Of recent years still more wonderful feats have been accomplished. Doctor Alexis Carrel, of the Rockefeller Institute of Research having succeeded in keeping detached portions of the body alive for months in suitable solutions. Doctor Carrel was also very successful in transplanting organs from one animal to another. He even received the Nobel prise for his method of suturing the blood-vessels of the parts together.*

It is therefore safe to say that operations, such as the one I have mentioned in this story, will at no distant date, be matters of everyday routine; and will seem as commonplace as the fact that we can now converse by telephone with friends hundreds of miles away.

PROLOGUE

THE circus performance was at its height. The trained seals had performed their wonderful feats of catching and balancing balls, and now it was the turn of the high diver, Miss Olla Podrida, as she was called on the bills. Her real name was Olive Bird, but Olive had been changed to Olla, and "Olla Podrida"—literally the Spanish for "A little of everything"—had struck the manager as making an attractive stage-name for the young girl.

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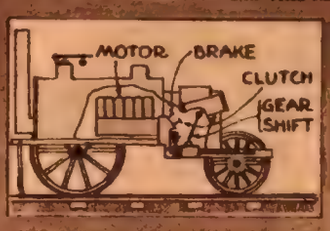
Replica of First Locomotive

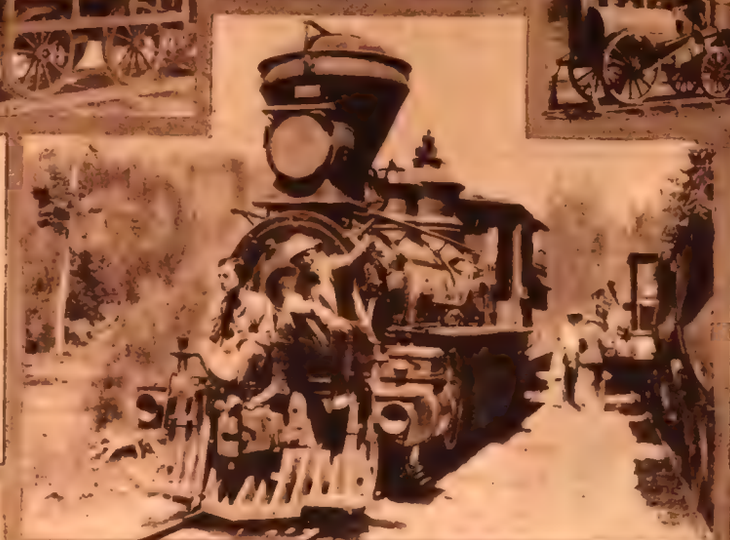
Stevenson's "Rocket" Rebuilt for Movies. Run by Auto Motor.

AN exact replica of Stevenson's "Rocket" was built in detail recently for the making of a Buster Keaton comedy. The story called for a trip in one of the first railroad trains so there was nothing for the technical director to do but rebuild one of the first trains. The only one in existence at the present time is the property of the New York Central Railroad and at the time the picture was taken it was on an exhibition trip in the East, making the freight charges on moving it considerable. At the right is a photo of the first train as it was constructed by the movie people, traveling over a stretch of road near the California studio. As it was for a narrow gauge track even the roadbed had to be built for it. Note the tender at the rear of the engine and the open baggage car following.

Below in the inset may be seen the method used by the Keaton technical director, Mr. Fred Gabouri, in constructing the engine. Of course, grinding cylinders, erecting and connecting a boiler, installing grates and lining up all the parts would have incurred a great deal more expense than was necessary. The necessity of all this shop work was obviated by simply making the engine out of sheet iron in the exact pattern of the original and then installing a good sized automobile engine in the boiler. The engine drove the locomotive through a worm gear to the back axle. Smoke was made to issue from the stack by the simple means of smoke-pots. Completed, the engine went over its course hauling the three cars at a fifteen mile an hour clip. The whole power unit with the engine was left intact, even to the brake.



Directly above is shown the engineer's place on the engine. The locomotive was so small that the engineer did his own firing. In this case, of course, the engineer did nothing but shift gears and apply the foot brake on the automobile engine. The wood in the tender was not used, being placed there to give realism to the picture. Note the wooden wheels on the locomotive and the short distance from the axle to the driving pin to which the connecting rod is attached. At the right we see Buster on a locomotive of a little later period, one that came into general use about the time of the first transcontinental railroad.



Above is shown the Keaton train in front of one of the villages it is supposed to pass through in its trip through the picture. Note that the buildings are simply shells erected by the movie producer especially for the picture. The technical director who built the locomotive estimated that the cost of the "Rocket's" construction and the building of the special lengths of narrow gauge track upon which it ran at about $20,000. The picture below graphically shows the old time methods of travel when 15 miles per hour was considered express time. If a diner had been hooked onto such a train it would have stopped it.

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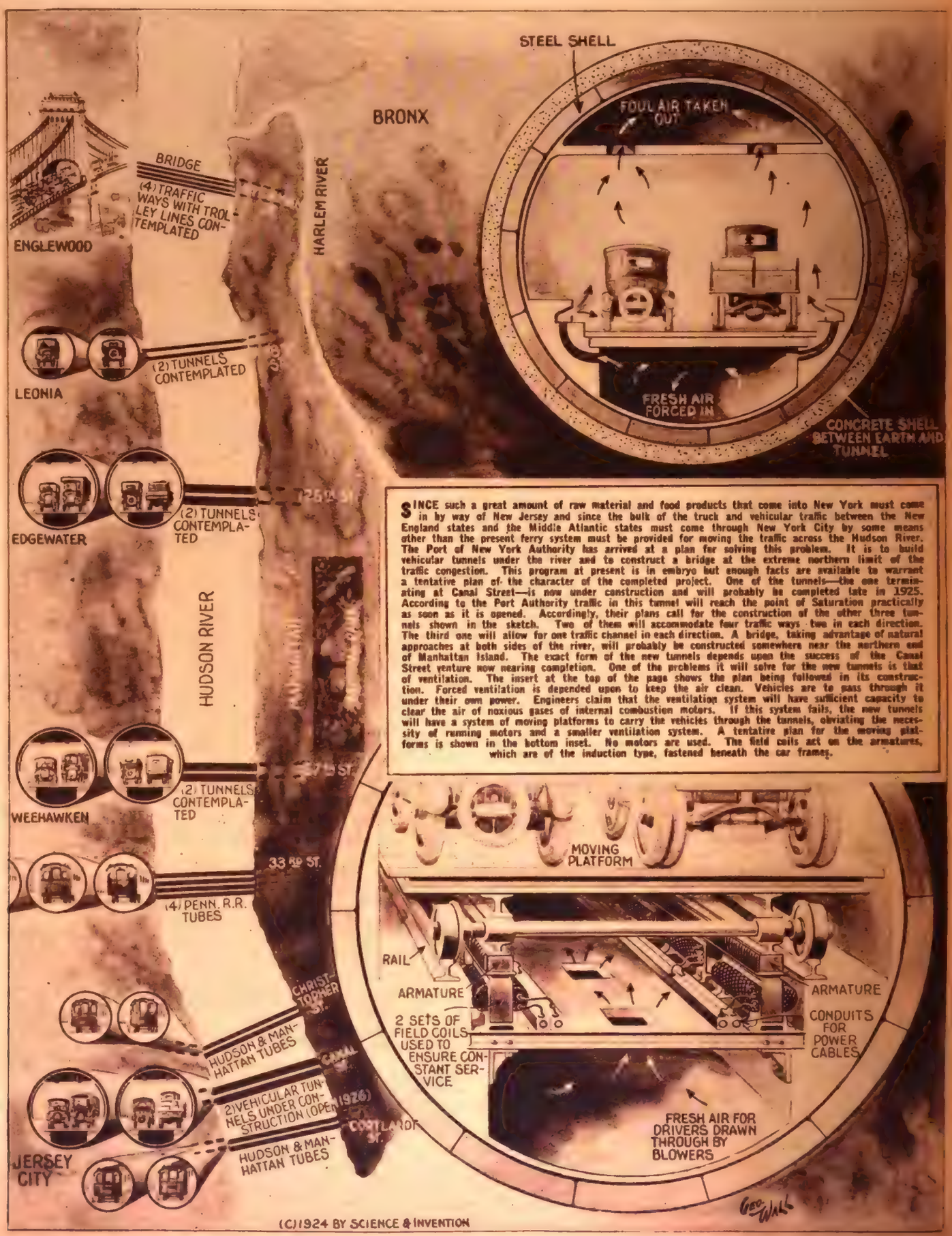
Eight Tunnels Under the Hudson

Vehicular Tunnels Under Hudson River Proposed to Relieve Traffic.

By W. B. ARVIN.



SINCE such a great amount of raw material and food products that come into New York must come in by way of New Jersey and since the bulk of the truck and vehicular traffic between the New England states and the Middle Atlantic states must come through New York City by some means other than the present ferry system must be provided for moving the traffic across the Hudson River. The Port of New York Authority has arrived at a plan for solving this problem. It is to build vehicular tunnels under the river and to construct a bridge at the extreme northern limit of the traffic congestion. This program at present is in embryo but enough facts are available to warrant a tentative plan of the character of the completed project. One of the tunnels—the one terminating at Canal Street—is now under construction and will probably be completed late in 1925. According to the Port Authority traffic in this tunnel will reach the point of Saturation practically as soon as it is opened. Accordingly, their plans call for the construction of the other three tunnels shown in the sketch. Two of them will accommodate four traffic ways two in each direction. The third one will allow for one traffic channel in each direction. A bridge, taking advantage of natural approaches at both sides of the river, will probably be constructed somewhere near the northern end of Manhattan Island. The exact form of the new tunnels depends upon the success of the Canal Street venture now nearing completion. One of the problems it will solve for the new tunnels is that of ventilation. The insert at the top of the page shows the plan being followed in its construction. Forced ventilation is depended upon to keep the air clean. Vehicles are to pass through it under their own power. Engineers claim that the ventilation system will have sufficient capacity to clear the air of noxious gases of internal combustion motors. If this system fails, the new tunnels will have a system of moving platforms to carry the vehicles through the tunnels, obviating the necessity of running motors and a smaller ventilation system. A tentative plan for the moving platforms is shown in the bottom inset. No motors are used. The field coils act on the armatures, which are of the induction type, fastened beneath the car frames.

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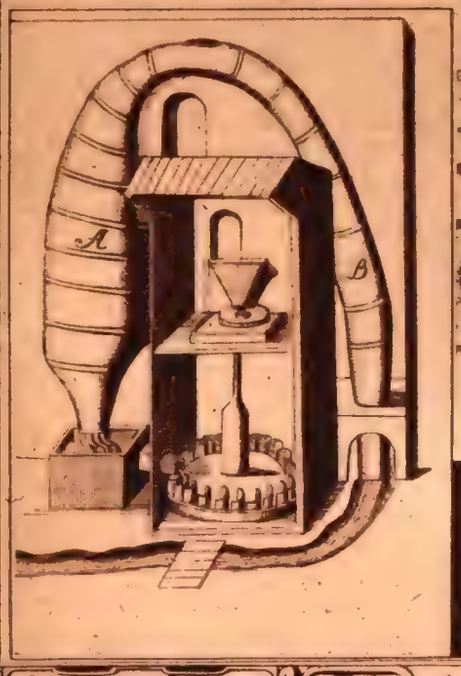
Ancient Perpetual Motion

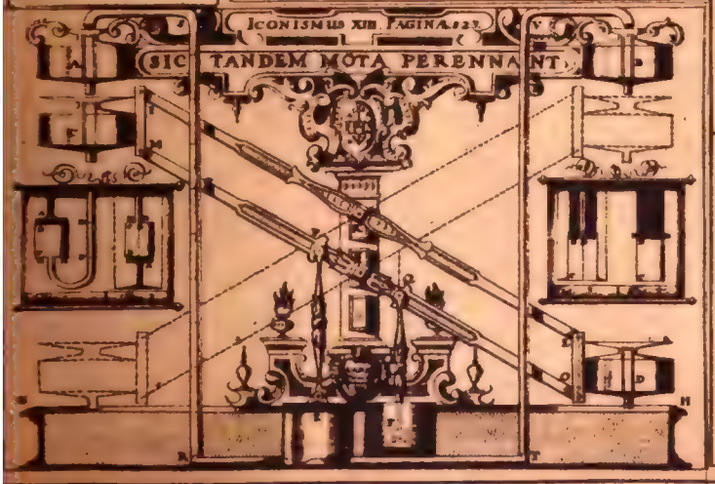
Perpetual Motion Schemes Invented During the 17th Century.

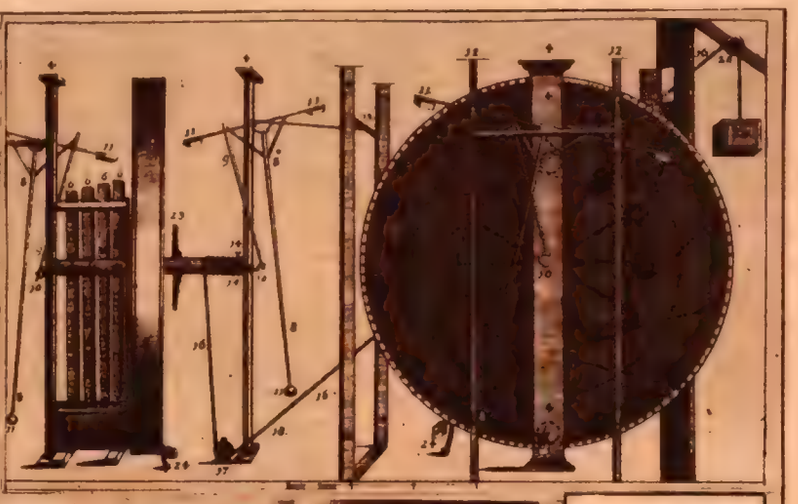
By DR. G. SCHMITZ.

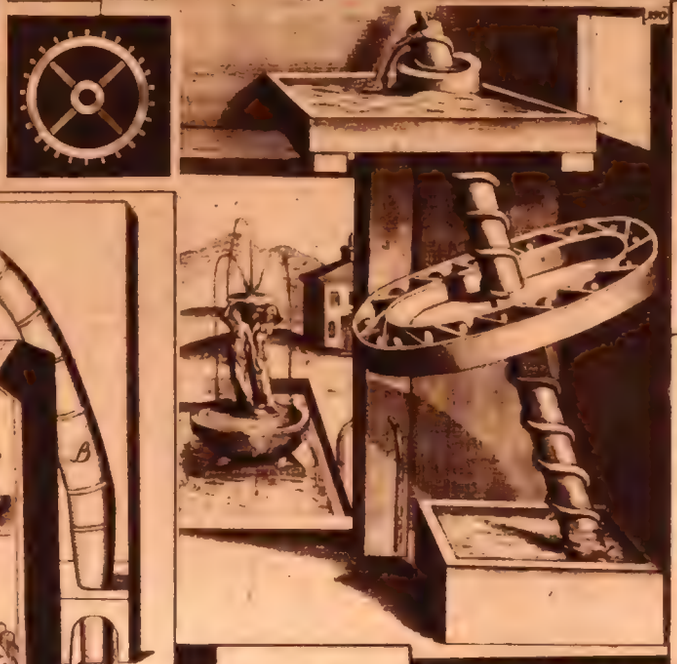
Above we see a mill of the 17th Century supposedly driven by a perpetual motion motor. The stone M, for grinding the grain is driven by water from tank A, which passes through trough B, actuating the blades of the turbine C, which transmit the motion through D to M. At the same time the toothed arrangement on D, drives gears F, G and H, turning the water screw K, and raising the water up into tank A again. L is a fly wheel.



At the right is a very old fallacy making use of the siphon principle. It is well known that one arm of a siphon must be longer than the other in order to permit it to operate. Then the flow will be in the direction of the longer arm. In order to increase the weight of water in the shorter arm, the inventor of this device increased the diameter. He believed that water from the river or stream could be raised above its own height.





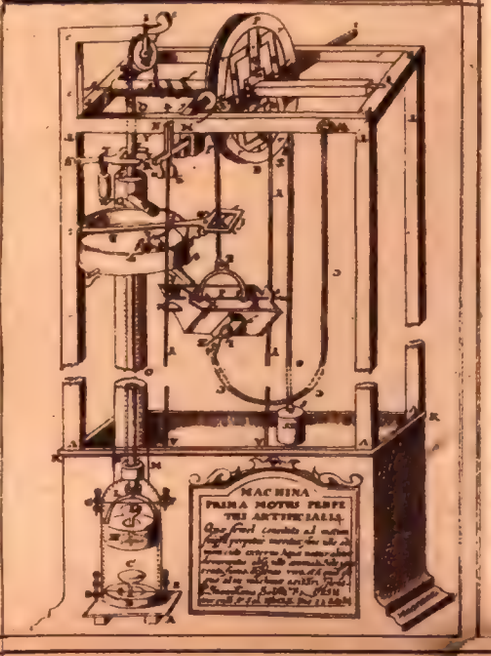


Above is shown the celebrated wheel of Orffyreus, which for a time amazed the world while it really seemed to go. Its inner arrangement recalls the wheel of the Marquis of Worcester. Finally the deceit came to light. The apparatus was rotated by means of concealed connections by the brother and servant of the inventor. There is no record as to whether stock was sold on the strength of the wheel.

Left. The principle of the weights being further from the center of the wheel on the descending side, than those on the ascending portion of the wheel is even today, thought to be capable of causing a wheel to turn. All wheels built according to this design have stood still, due to the fact that there is always a preponderance of weights which have to be raised, while some falling weights develop no power.

Right. Z is a water vessel which on rising opened valve H, and the vessel B. When it was full the weight of the water was supposed to carry it down and at the same time operate a pump, which was to fill the vessel B with water. When Z reached the bottom, it was to be tipped by rope C, and the counterpoise was to raise it to the top again.

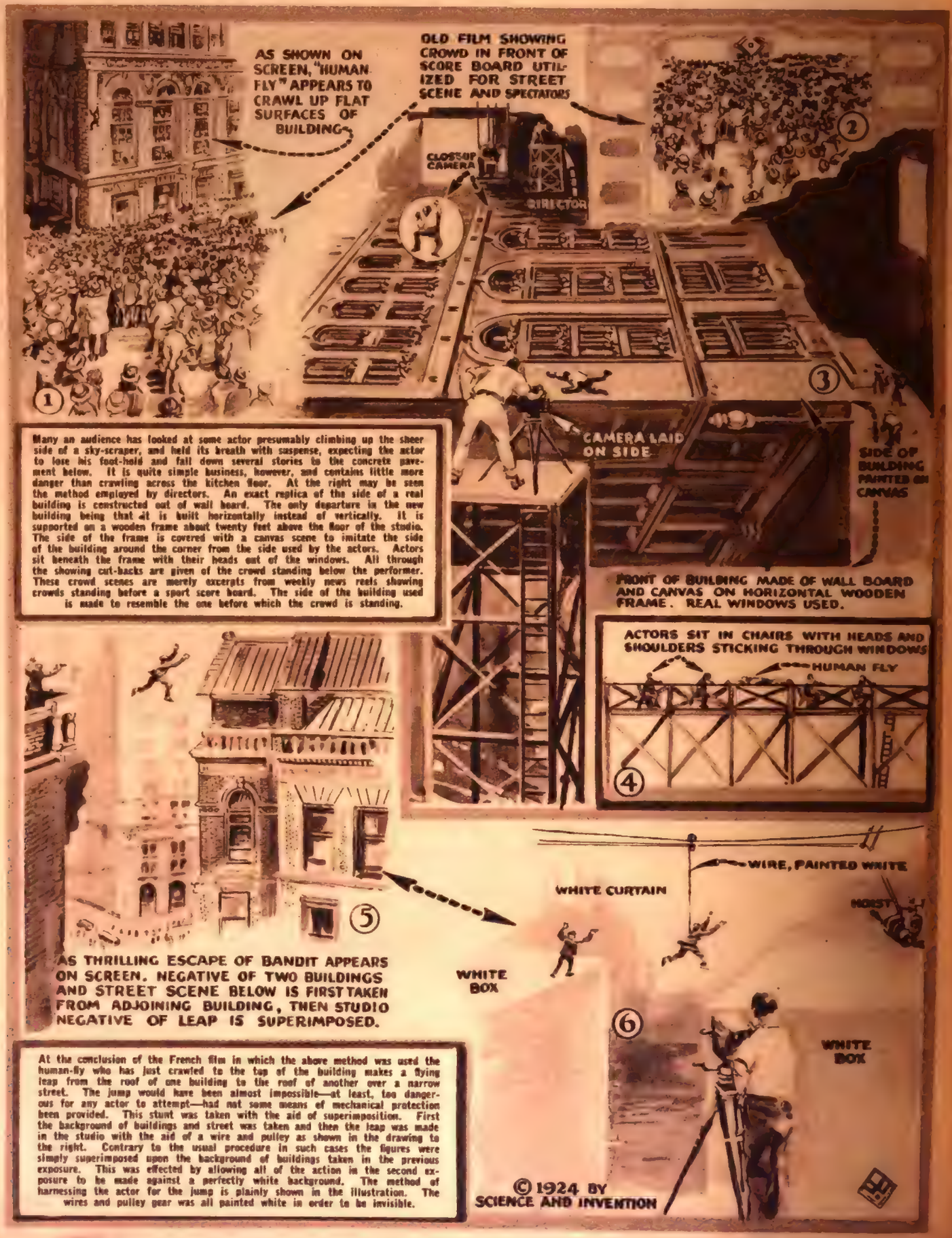
Left. The vessel D is filled from the tank B, and then by its own weight goes down. Meanwhile vessel C which has just been emptied, is pulled up by D. Water is forced from the pump F into container A. The device did not work. Reason—water cannot be lifted to a greater height by a force exerted by an equivalent amount of water falling through a shorter distance.



Google

Making "Human-Fly" Pictures

Actor Crawls Up Side of Horizontal Building


AS SHOWN ON SCREEN, "HUMAN FLY" APPEARS TO CRAWL UP FLAT SURFACES OF BUILDING
OLD FILM SHOWING CROWD IN FRONT OF SCORE BOARD UTILIZED FOR STREET SCENE AND SPECTATORS
CLOSE-UP CAMERA
DIRECTOR
1
2
3
CAMERA LAID ON SIDE
SIDE OF BUILDING PAINTED ON CANVAS
FRONT OF BUILDING MADE OF WALL BOARD AND CANVAS ON HORIZONTAL WOODEN FRAME. REAL WINDOWS USED.
ACTORS SIT IN CHAIRS WITH HEADS AND SHOULDERS STICKING THROUGH WINDOWS
HUMAN FLY
4
5
AS THRILLING ESCAPE OF BANDIT APPEARS ON SCREEN, NEGATIVE OF TWO BUILDINGS AND STREET SCENE BELOW IS FIRST TAKEN FROM ADJOINING BUILDING, THEN STUDIO NEGATIVE OF LEAP IS SUPERIMPOSED.
WIRE, PAINTED WHITE
WHITE CURTAIN
HOIST
WHITE BOX
6
WHITE BOX

Many an audience has looked at some actor presumably climbing up the sheer side of a sky-scraper, and held its breath with suspense, expecting the actor to lose his foot-hold and fall down several stories to the concrete pavement below. It is quite simple business, however, and contains little more danger than crawling across the kitchen floor. At the right may be seen the method employed by directors. An exact replica of the side of a real building is constructed out of wall board. The only departure in the new building being that it is built horizontally instead of vertically. It is supported on a wooden frame about twenty feet above the floor of the studio. The side of the frame is covered with a canvas scene to imitate the side of the building around the corner from the side used by the actors. Actors sit beneath the frame with their heads out of the windows. All through the showing cut-backs are given of the crowd standing below the performer. These crowd scenes are merely excerpts from weekly news reels showing crowds standing before a sport score board. The side of the building used is made to resemble the one before which the crowd is standing.

At the conclusion of the French film in which the above method was used the human-fly who has just crawled to the top of the building makes a flying leap from the roof of one building to the roof of another over a narrow street. The jump would have been almost impossible—at least, too dangerous for any actor to attempt—had not some means of mechanical protection been provided. This stunt was taken with the aid of superimposition. First the background of buildings and street was taken and then the leap was made in the studio with the aid of a wire and pulley as shown in the drawing to the right. Contrary to the usual procedure in such cases the figures were simply superimposed upon the background of buildings taken in the previous exposure. This was effected by allowing all of the action in the second exposure to be made against a perfectly white background. The method of harnessing the actor for the jump is plainly shown in the illustration. The wires and pulley gear was all painted white in order to be invisible.

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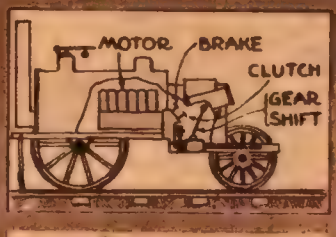
Replica of First Locomotive

Stevenson's "Rocket" Rebuilt for Movies. Run by Auto Motor.

AN exact replica of Stevenson's "Rocket" was built in detail recently for the making of a Buster Keaton comedy. The story called for a trip in one of the first railroad trains so there was nothing for the technical director to do but rebuild one of the first trains. The only one in existence at the present time is the property of the New York Central Railroad and at the time the picture was taken it was on an exhibition trip in the East, making the freight charges on moving it considerable. At the right is a photo of the first train as it was constructed by the movie people, traveling over a stretch of road near the California studio. As it was for a narrow gauge track even the roadbed had to be built for it. Note the tender at the rear of the engine and the open baggage car following.

Below in the inset may be seen the method used by the Keaton technical director, Mr. Fred Gabouri, in constructing the engine. Of course, grinding cylinders, erecting and connecting a boiler, installing grates and lining up all the parts would have incurred a great deal more expense than was necessary. The necessity of all this shop work was obviated by simply making the engine out of sheet iron in the exact pattern of the original and then installing a good sized automobile engine in the boiler. The engine drove the locomotive through a worm gear to the back axle. Smoke was made to issue from the stack by the simple means of smoke-pots. Completed, the engine went over its course hauling the three cars at a fifteen mile an hour clip. The whole power unit with the engine was left intact, even to the brake.



Directly above is shown the engineer's place on the engine. The locomotive was so small that the engineer did his own firing. In this case, of course, the engineer did nothing but shift gears and apply the foot brake on the automobile engine. The wood in the tender was not used, being placed there to give realism to the picture. Note the wooden wheels on the locomotive and the short distance from the axle to the driving pin to which the connecting rod is attached. At the right we see Buster on a locomotive of a little later period, one that came into general use about the time of the first transcontinental railroad.

Above is shown the Keaton train in front of one of the villages it is supposed to pass through in its trip through the picture. Note that the buildings are simply shells erected by the movie producer especially for the picture. The technical director who built the locomotive estimated that the cost of the "Rocket's" construction and the building of the special lengths of narrow gauge track upon which it ran at about $20,000. The picture below graphically shows the old time methods of travel when 15 miles per hour was considered express time. If a diner had been hooked onto such a train it would have stopped it.

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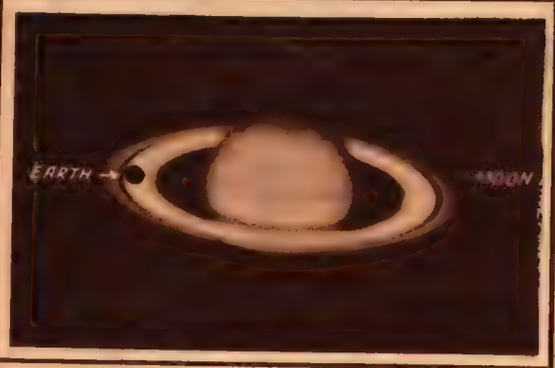
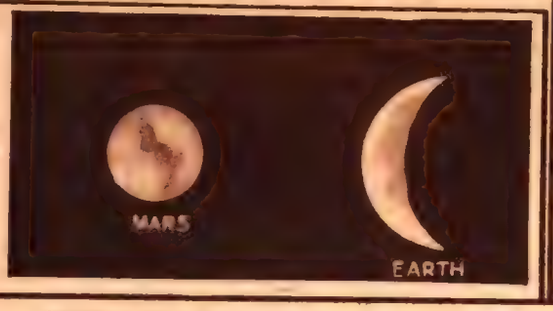
Earth and Moon Compared

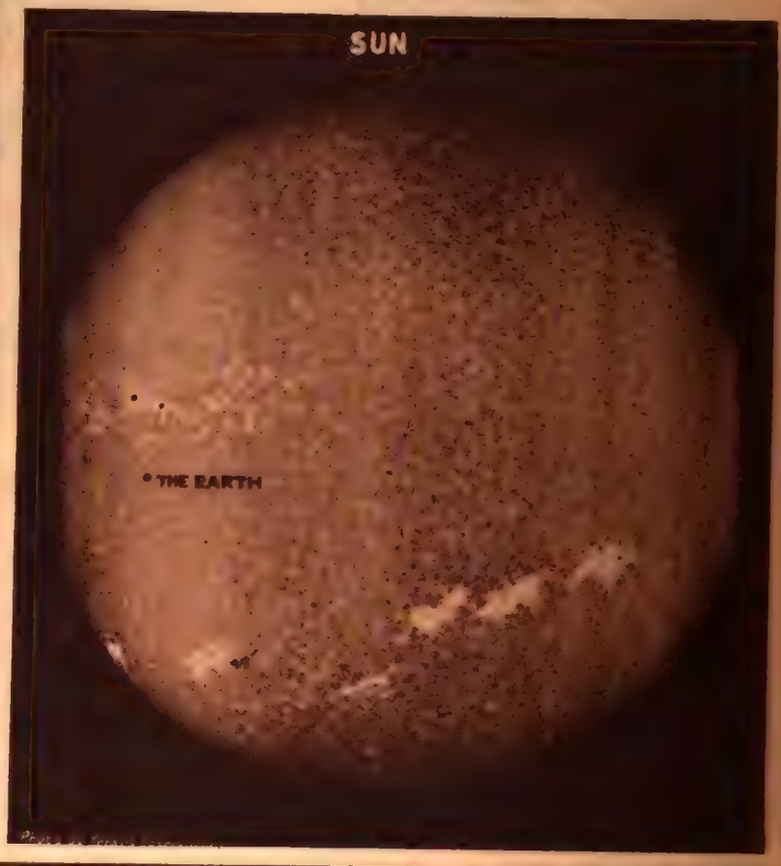
How Our Planet Measures Up With Mars, Saturn and Venus.

By ISABEL M. LEWIS, M. A.
OF THE U. S. NAVAL OBSERVATORY



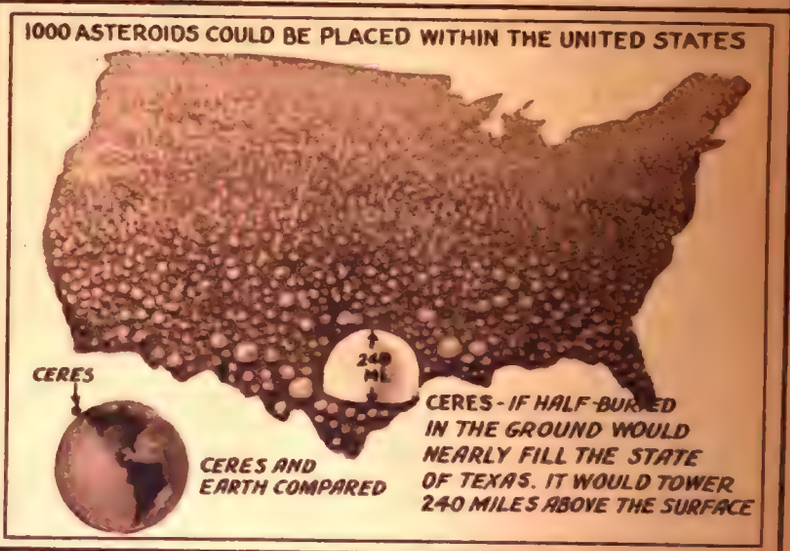
COMPARED to Saturn the earth does not cut so graceful a figure as to size. In fact, the earth is not as large in diameter as the inner ring which surrounds that planet. As for the moon, it would just about fit in the space between the inner and the outer rings. In the illustration above our satellite is hardly more than a spot on the paper as compared to the gigantic ringed sphere that floats around the sun even as the earth. If the earth were superimposed upon the bright ring it would be just four-ninths as wide as the ring. The moon, which is about 2,200 miles in diameter, would slip comfortably into Cassini's division between bright, wide, inside ring and the outer one. The width of the bright ring is approximately 18,000 miles while the diameter of the earth is 8,000 miles. This gives a good idea of the earth's size.





Comparisons indeed become odious when the size of the earth is projected upon the disk of the sun. Quite a quantity of earths could be dumped into the sun without any appreciable effect being produced upon the center of our solar system. One of the best ideas of the earth's size as compared with the master of this solar system's activities may be gained by comparing the small spot that represents the earth (in the above illustration) with those which represent the much discussed sun spots. Two of these spots may be seen directly above the earth's projection. The above photograph of the sun was taken by the light of calcium and plainly shows the umbras or central darkest portion of the above mentioned sun spots. The diameter of the sun is 864,000 miles while that of the earth is 8,000. In the small photograph at the left the earth is compared with Mars. The photograph of Mars was taken by Prof. Barnard with a 40-inch refractor telescope at Yerkes Observatory during the last close opposition of Mars to the earth which occurred in September, 1909. The diameter of Mars is 4,120 miles. The crescent representing the earth shows how our planet would appear through a telescope of the same magnification made at the same time the photograph was taken if the observation were made from Mars. At the exact time of the opposition the earth is invisible from Mars since it lies directly between that planet and the sun. Just before and after the opposition, however, the earth would appear to an observer on our neighbor planet as the slender crescent shown in the illustration. An observer on that planet could never see the earth as plainly as astronomers here are able to view Mars. When the two planets are closest together the earth is very unfavorably placed for observation while we can see Mars plainly.

Here the earth and Venus are compared. The illustration of the earth shows how it would appear to observers on Venus if the observations were taken at the time the photograph of Venus was taken from the earth. Of course, both photographs would have to be taken with the aid of a telescope. The present photograph of our sister planet was taken by Prof. Barnard with the 40-inch refracting telescope at Yerkes Observatory. It was taken at an inferior conjunction with the sun. At the time the earth was near opposition with all of the disk illuminated as shown. A telescopic photograph from Venus would have disclosed large dark areas following pretty closely the outlines of the continents. From Venus at the time mentioned a much clearer view of the earth could be gained from that planet than from Mars. The moon is placed near the earth in the drawing and is shown to be about one-fourth the diameter of the earth. At the right is given a comparative measure of the size of the earth and the smaller members of the solar system—the Asteroids. However, we do not need the whole earth for such a measurement since the United States is large enough to hold all of them. A comparison of the largest of the lot, Ceres, and the earth is given, however, as a means of connecting their size with the other members of the system. If Ceres should leave its path and strike the earth, light squarely in the middle of Texas and sink into the ground about half way, Texas would become a mountain about 240 miles in height. If all of these small members, following their own course around the sun, each in its individual orbit, should strike the United States they would all be accommodated and there would still be room for a few farms and cities left over. There are about a thousand of these Asteroids now known.


1000 ASTEROIDS COULD BE PLACED WITHIN THE UNITED STATES
CERES
240 MI.
CERES AND EARTH COMPARED
CERES - IF HALF-BURIED IN THE GROUND WOULD NEARLY FILL THE STATE OF TEXAS. IT WOULD TOWER 240 MILES ABOVE THE SURFACE

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To the Sun, Moon and Planets

Terrestrial Areas Compared to the Moon.

By ISABEL M. LEWIS, M. A.
OF THE U. S. NAVAL OBSERVATORY

The above photograph of the moon taken at the Yerkes Observatory with an inverting telescope serves very well as a map of the earth's satellite. The names of a number of the points of interest on the surface of the moon are given. The above illustration gives an idea more of the general contour with the various areas of discoloration while the illustration below is devoted more to the details which are not shown in the above. The Sea of Fertility, as one of the dark areas is called, is practically equal in size to the State of California. There is no standard theory as to what these areas are. To get an idea of the complete size of the moon the stretch just below shows how the moon would appear superimposed upon the United States. It would cover practically all of the country to the Rocky Mountains and would lap over north and south.

MOON 2,160 MI.

The photograph at the right gives a little more clearly the details of the moon's surface but it takes in only a little more than half of the full disk of the satellite. It was taken through a 40-inch refractor at Yerkes with the aid of a color screen. Many of the points shown in the above photo are given in this one and the craters and the general rough appearance of the surface is much more plainly indicated. The Ptolemy crater seen just a little above the center of the photo at the left margin is about 115 miles in diameter and incloses an area equal in size to the State of Massachusetts. In the south quarter in this photograph the whole surface of the moon, almost, is covered with these crater-like configurations. Many of them are land-marks on the surface of our satellite and have been named by astronomers. Other facts regarding its surface are referred to some one of the known land-marks in order to place it. The Plato crater which lies toward the northern extremity is about 60 miles in diameter. Copernicus is probably the most well known of all the spots on the moon. Most every amateur astronomer knows it. It lies in the middle of a large area marked by the Sea of Showers to the north, the Ocean of Storms to the east (this contains an area of a little more than 2,000,000 square miles), the Sea of Clouds (from which juts the Sea of Moisture like a little headland) on the south and the Sea of Vapors on the west. The little Sea of Moisture is approximately the size of England. Mare Crisium, a little below Fertility and just to the west of Tranquility is a bit over 70,000 square miles in area making it about the size of North Dakota or Wyoming. Beginning at Plato and running south in an uneven line is a string of five craters that are interesting, the smallest one of the group being 23 miles in diameter. After passing an open space, further to the south is found a whole cluster of craters. After dis-

Another comparison of the size of the earth to one of the larger planets is seen above. The spot representing the earth may be seen above the shadow of the III Satellite of Jupiter. The planet itself is of course, represented by the large circle. This photograph of the huge planet was taken by E. C. Slipher at the Lowell Observatory with the aid of a 24-inch refracting telescope. At the right may be seen the size of the earth compared with a Solar Prominence. This great eruptive Prominence is no less than 160,000 miles in height. It was photographed at the Yerkes Observatory. The globe representing the earth may be seen toward the top of the photograph. Of course, in all the comparative pictures the sizes are drawn to scale and superimposed on the photographs.

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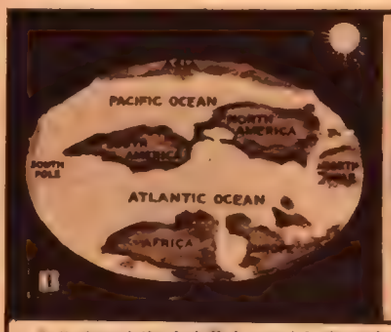
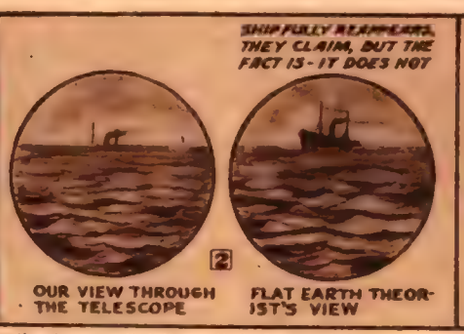
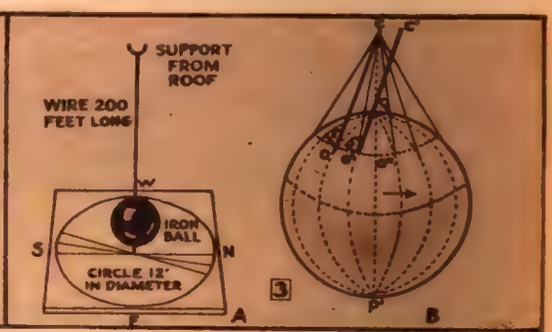
Is the World Flat; Does It Move?

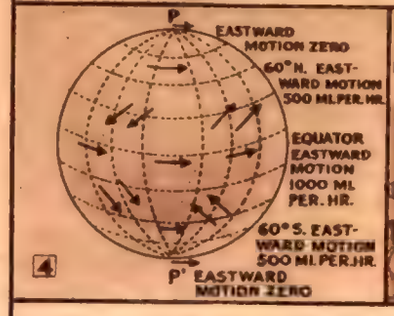
Several Proofs That the World is a Sphere and Moves

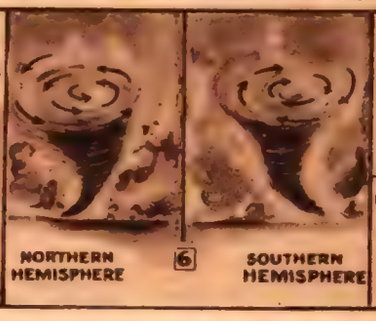


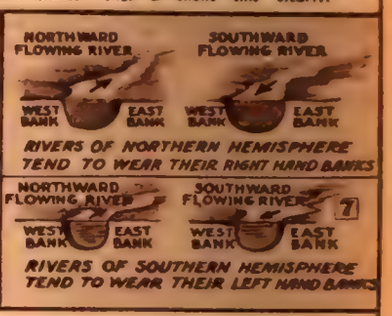




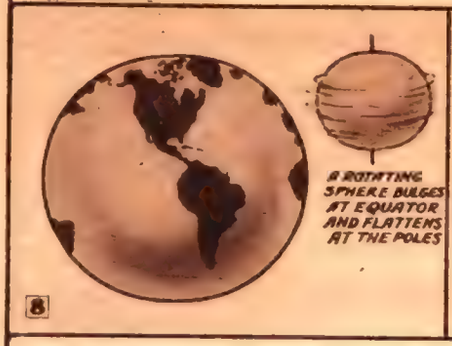
IN view of the fact that several books pretending to prove that the earth is flat have been brought to the attention of the editor during the past month several proofs of the earth's sphericity given by Isabel M. Lewis, M. A., are reproduced. Several of them are more or less unknown to the layman. The first one, of course, is, that if a traveler journeys due east or west he will return to his starting point. This could not happen except on a spherical earth. Another standard proof is the fact that vessels at sea always appear masts first to the observer on land. The curvature of the earth hides the hull of the vessel. A more complicated proof is Foucault's pendulum. If a pendulum is constructed as shown in the above sketch, it will be found to make its way partly around a circle, in the northern and southern hemispheres while at the equator it will continue to swing in one plane continuously. Also, the rate at which it travels around the circle will be a fixed relation to the latitude in which the experiment is performed. A pendulum always swings in the same plane, if undisturbed, so as the earth moves, the angle of the marks which the pendulum makes in the sand is changed in relation to the original plane. Fig. B shows this clearly.

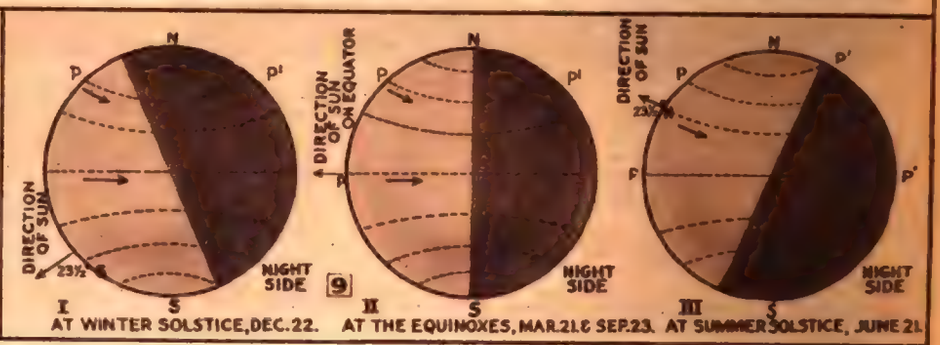

P
EASTWARD MOTION ZERO
60° N. EASTWARD MOTION 500 MI. PER. HR.
EQUATOR EASTWARD MOTION 1000 MI. PER. HR.
60° S. EASTWARD MOTION 500 MI. PER. HR.
P' EASTWARD MOTION ZERO
4



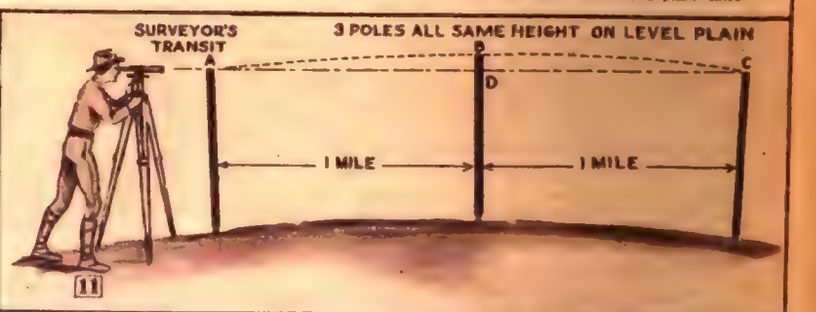

NORTHWARD FLOWING RIVER
SOUTHWARD FLOWING RIVER
WEST BANK
EAST BANK
RIVERS OF NORTHERN HEMISPHERE TEND TO WEAR THEIR RIGHT HAND BANKS
7
RIVERS OF SOUTHERN HEMISPHERE TEND TO WEAR THEIR LEFT HAND BANKS

The rotation of the earth is the only means of explaining the steady trade winds and their almost constant directions. One of the surest proofs of the earth's revolution is the fact that shells from large guns are pulled off their course when fired in a northerly or southerly direction. If a projectile were fired with sufficient strength and there were no conditions to disturb its course this deviation caused by the earth's rotation could be measured. The same cause results in the bend that is visible in every cyclone. All pictures of them show this peculiarity. The fact that they bend in one direction in the northern hemisphere and in the opposite direction in the southern hemisphere is only another proof that the world rotates. The same principle causes the wear in river banks illustrated directly above.





Any physics laboratory can prove that a sphere rotating will tend to bulge at its equator and to become flattened at its poles. This is true of the earth and has been proven many times. In the diagram at the right is a plan showing the reason for the difference in the length of days and nights at the different seasons of the year. At the equator the days and nights are of nearly the same length. In the northern and southern latitudes, however, the periods are of different lengths on account of the earth's rotation around the sun and on account of the tilt of the earth's axis. The shaded portion of the different spheres represent the dark periods. By taking any point, P, on the spheres and following them around it will be evident that the dark portion does not cut the parallels of latitude in equal parts except at the equinoxes. At other times the days are longer or shorter according to the earth's position. How can the flat-earth theorists explain this?



Another question for the flat-earth theorists to answer is how the northern winters are seven days shorter than the northern summers? On the proper theory that the earth is round and does both revolve and move around the sun the question is easily answered. The difference of seven days in the length of time that the sun is north and south of the equator respectively arises from the fact that the earth travels around the sun in an ellipse instead of a circle. When it is in perihelion, or nearest the sun,—which occurs in the winter of the northern hemisphere and summer of the southern hemisphere—it moves more rapidly than when it is in apheHon—which occurs in the northern summer and in the southern winter. The resulting difference between the length of time that the sun is north and south of the equator amounts to seven days. This movement of the earth in regard to the sun is illustrated in the diagram at the left. One of the clearest proofs of the earth's curvature is shown at the right. With a surveyor's transit, posts and a level stretch of land, the curvature (B-D=8 inches) is clearly measurable.

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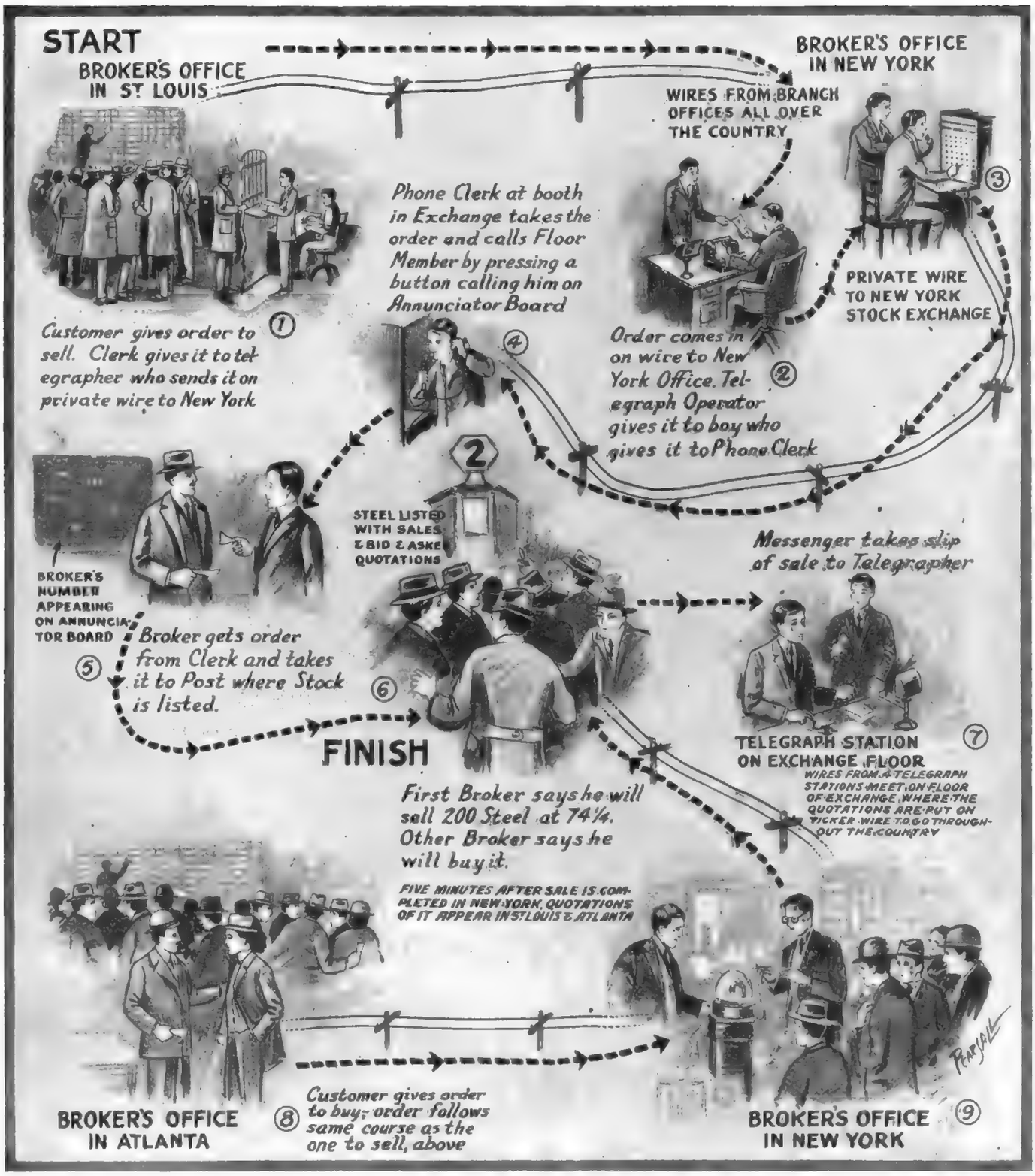
Mechanics of a Stock Sale

Complicated System of Private Wires Covers Country


START
BROKER'S OFFICE IN ST. LOUIS
BROKER'S OFFICE IN NEW YORK
WIRES FROM BRANCH OFFICES ALL OVER THE COUNTRY
Phone Clerk at booth in Exchange takes the order and calls Floor Member by pressing a button calling him on Annunciator Board
PRIVATE WIRE TO NEW YORK STOCK EXCHANGE
Customer gives order to sell. Clerk gives it to telegrapher who sends it on private wire to New York
1
Order comes in on wire to New York Office. Telegraph Operator gives it to boy who gives it to Phone Clerk
2
3
4
STEEL LISTED WITH SALES & BID & ASKED QUOTATIONS
BROKER'S NUMBER APPEARING ON ANNUNCIATOR BOARD
Messenger takes slip of sale to Telegrapher
Broker gets order from Clerk and takes it to Post where Stock is listed.
5
6
FINISH
TELEGRAPH STATION ON EXCHANGE FLOOR
7
WIRES FROM A TELEGRAPH STATIONS MEET ON FLOOR OF EXCHANGE WHERE THE QUOTATIONS ARE PUT ON TICKER WIRE TO GO THROUGHOUT THE COUNTRY
First Broker says he will sell 200 Steel at 74¼. Other Broker says he will buy it.
FIVE MINUTES AFTER SALE IS COMPLETED IN NEW YORK, QUOTATIONS OF IT APPEAR IN ST. LOUIS & ATLANTA
BROKER'S OFFICE IN ATLANTA
8
Customer gives order to buy; order follows same course as the one to sell, above
BROKER'S OFFICE IN NEW YORK
9

CONTRARY to the general opinion that most of the business of Wall Street is done by New Yorkers are the mechanical facts of the case. Every town of any size in the country has its branch broker's office with a private wire to the New York office and another private wire carrying ticker service. Above is graphically shown how a sale is made. In a broker's office in St. Louis a patron gives an order to sell, say, 200 shares of a steel stock after he has looked at the quotation on the ticker, which is operated from the floor of the central stock exchange in New York City. At some other branch office, say in Atlanta, another customer looking for securities gives an order to his local broker to buy 200 steel. These two orders are carried to New York over leased wires. There a telegrapher receives the message in the broker's office and it is telephoned to a clerk in a booth on the floor of the exchange. He presses a button which causes a number—the number of his employer—to show on a huge annunciator board at the end of the exchange floor. The floor members representing the two brokerage houses from whose branches the orders originated, go to the phone booth and take the order. They then rush to the post on the floor where the steel stock is listed. They then dicker, and the sale completed, a messenger lists the sale and takes a notation of it to one of the four telegraphers on the floor of exchange, whence it is sent out on the ticker. Five minutes after the two men have given their orders, the ticker records the sale in the two offices as it was made in New

Irwin.

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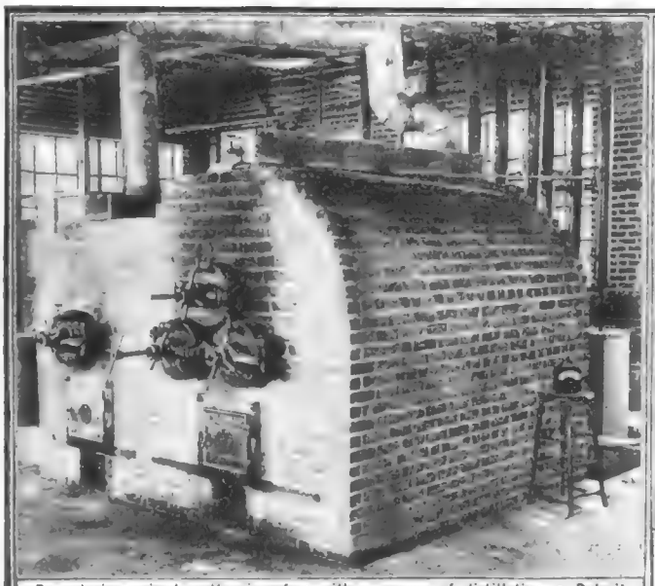
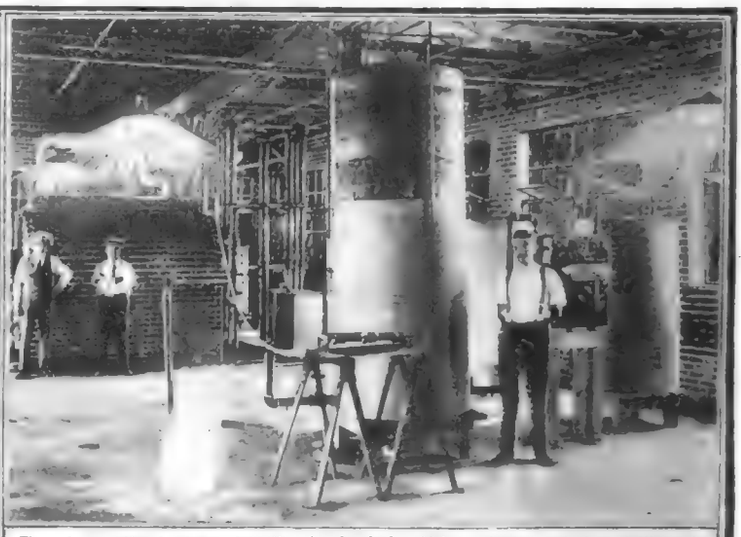
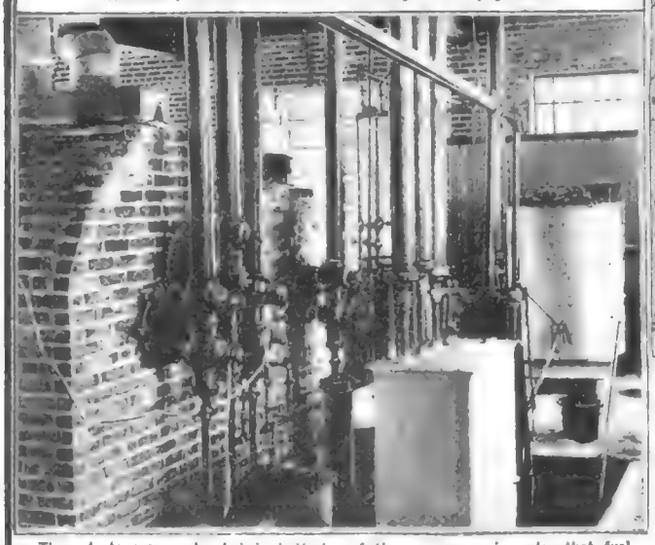
Garbage Turned Into Profits



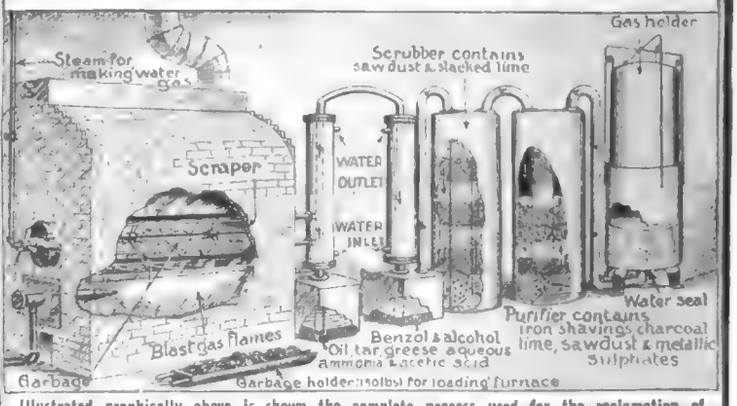
By reducing animal matter in refuse with a process of distillation, a Detroit chemist has evolved a plan for producing illuminating gas, coal tar products, fertilizers, charcoal and coke from sewage and city garbage.



The refuse matter is thrown into the closed retorts which are heated and the volatile matter is driven off through a series of condensers and cleaners, which abstract the coal tar products, leaving a good grade of illuminating gas.

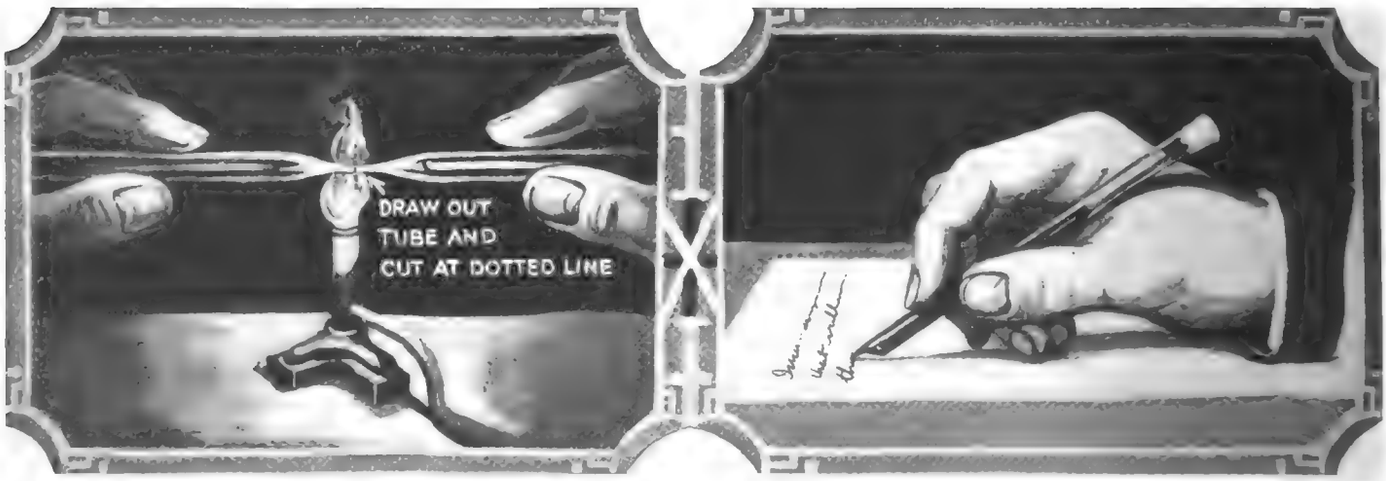


The retorts are constructed in batteries of three or more, in order that fuel may be saved in heating them. A temperature of 400 degrees C. is maintained within the retorts. This temperature is ample to break down the waste.



Illustrated graphically above is shown the complete process used for the reclamation of all waste containing carbon. The waste is first thrown into the retort, and the gas carried through scrubbers and cleaners—shown to the right of the diagram—finally into a gas-holder. After a number of experiments had been carried out by the manufacturers of the apparatus, it was found that a ton of ordinary city garbage can be reduced by this process in a little less than three hours, producing the following products: Between 600 and 1,000 pounds of distillate containing ether, alcohol and benzol; between 150 and 300 pounds of carbon fertilizer containing a high percentage of nitrogen, phosphorous and potash; 10,000 cubic feet of illuminating gas, which is used to fire the furnace. Experiments were also conducted in order to test the value of waste wood, saw-dust and bagasse (the waste resulting from the grinding of sugar cane), and results were found to be even more satisfactory than those in reducing city waste. It was found that a ton of saw-dust or other wood waste material could be reduced by this process in slightly less than 80 minutes. —M. P. P. Riis.

A Stylographic Fountain Pen



A very efficient fountain pen may be made by drawing out a glass tube of about the diameter of an ordinary pen, as shown above. When it is drawn to a fine point in a Bunsen flame, or gas range, the end is drawn to about the size of a needle. It is then broken, as shown by the dotted line, and the end again heated, after which it is blown through to form a small hole. A bit of cotton is pressed down the tube covering the outlet at the bottom. —Kenneth B. Murray.

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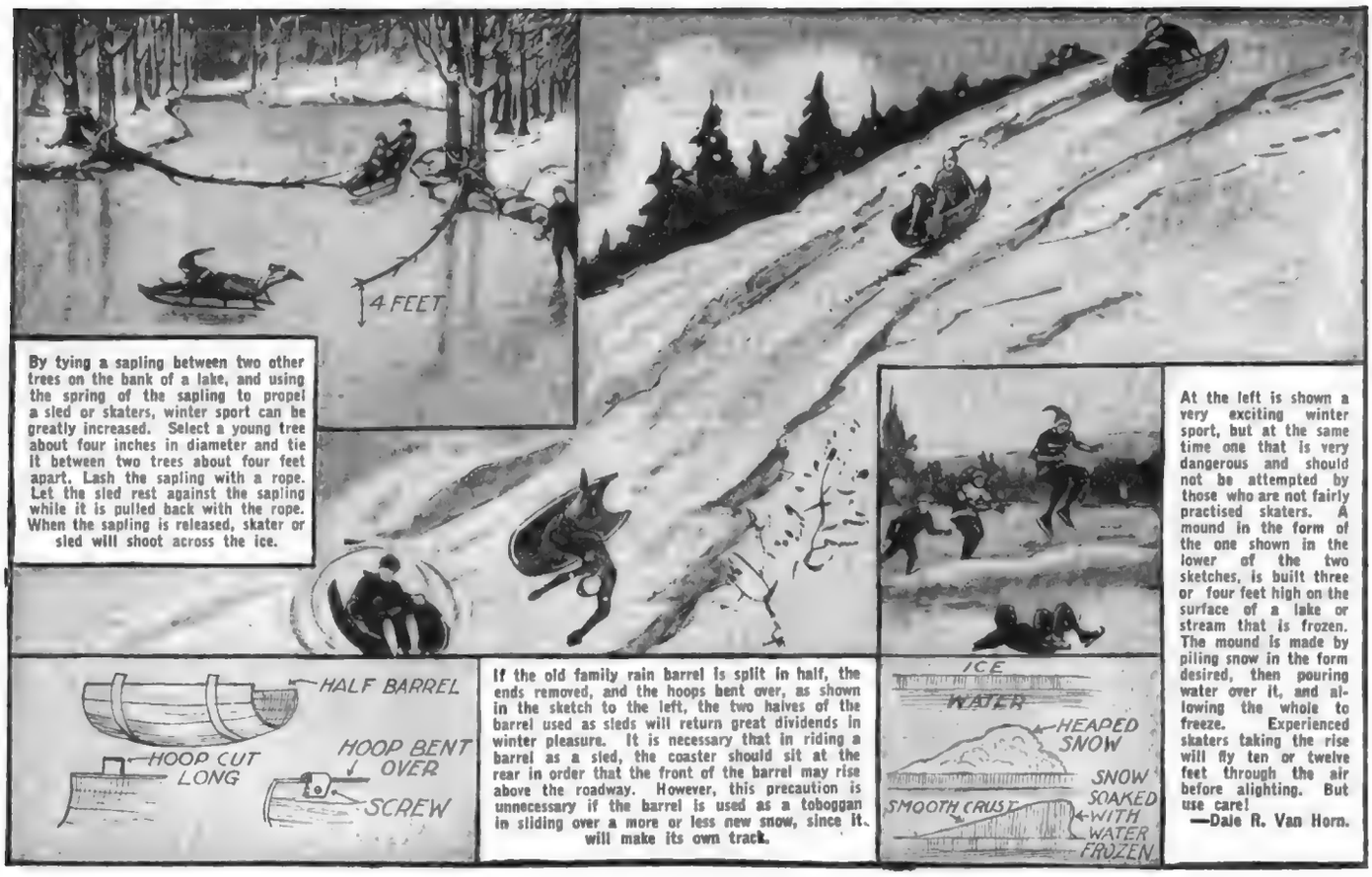
Fun on the Ice and Snow



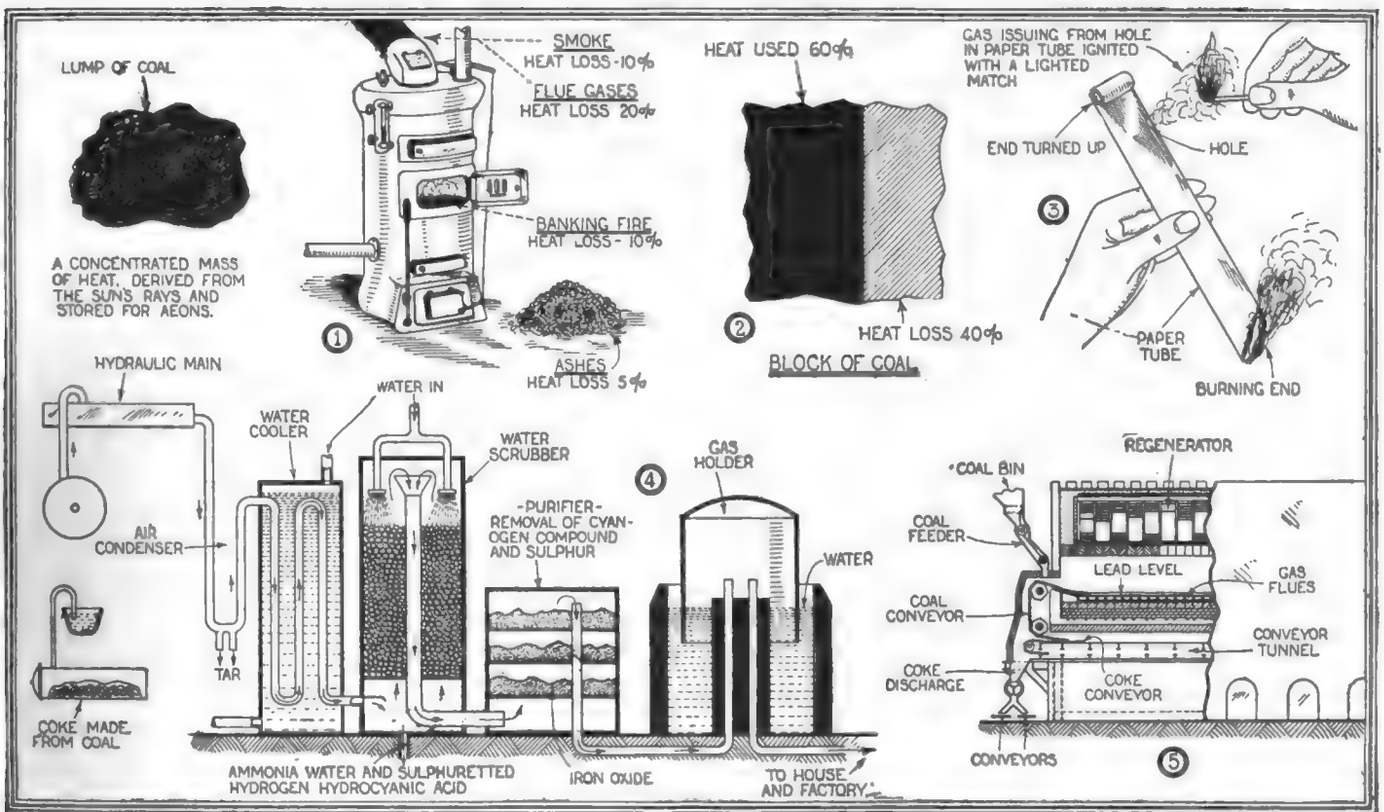
By tying a sapling between two other trees on the bank of a lake, and using the spring of the sapling to propel a sled or skaters, winter sport can be greatly increased. Select a young tree about four inches in diameter and tie it between two trees about four feet apart. Lash the sapling with a rope. Let the sled rest against the sapling while it is pulled back with the rope. When the sapling is released, skater or sled will shoot across the ice.

If the old family rain barrel is split in half, the ends removed, and the hoops bent over, as shown in the sketch to the left, the two halves of the barrel used as sleds will return great dividends in winter pleasure. It is necessary that in riding a barrel as a sled, the coaster should sit at the rear in order that the front of the barrel may rise above the roadway. However, this precaution is unnecessary if the barrel is used as a toboggan in sliding over a more or less new snow, since it will make its own track.

At the left is shown a very exciting winter sport, but at the same time one that is very dangerous and should not be attempted by those who are not fairly practised skaters. A mound in the form of the one shown in the lower of the two sketches, is built three or four feet high on the surface of a lake or stream that is frozen. The mound is made by piling snow in the form desired, then pouring water over it, and allowing the whole to freeze. Experienced skaters taking the rise will fly ten or twelve feet through the air before alighting. But use care!

—Dale R. Van Horn.

BURNING COAL TWICE



At the top of the above sketch is graphically illustrated the usual efficiency with which coal is burned. About sixty per cent of the fuel is used as actual heat, the remainder being wasted through various losses. At the extreme right on top is shown the inflammability of gases produced in burning paper which are not consumed in the flame. Below at the left is shown the method of burning coal twice, i.e., heating it in a closed retort, taking off the volatile products in the form of illuminating gas and coal tar products with the resulting coke. At 5 is illustrated the gas producing methods used [illegible] Detroit plant where the gas is driven off by passing the coal in buckets [illegible] method produces the reaction much more thoroughly and at a [illegible] the heated retort process.

—Ismar Ginsb[illegible]

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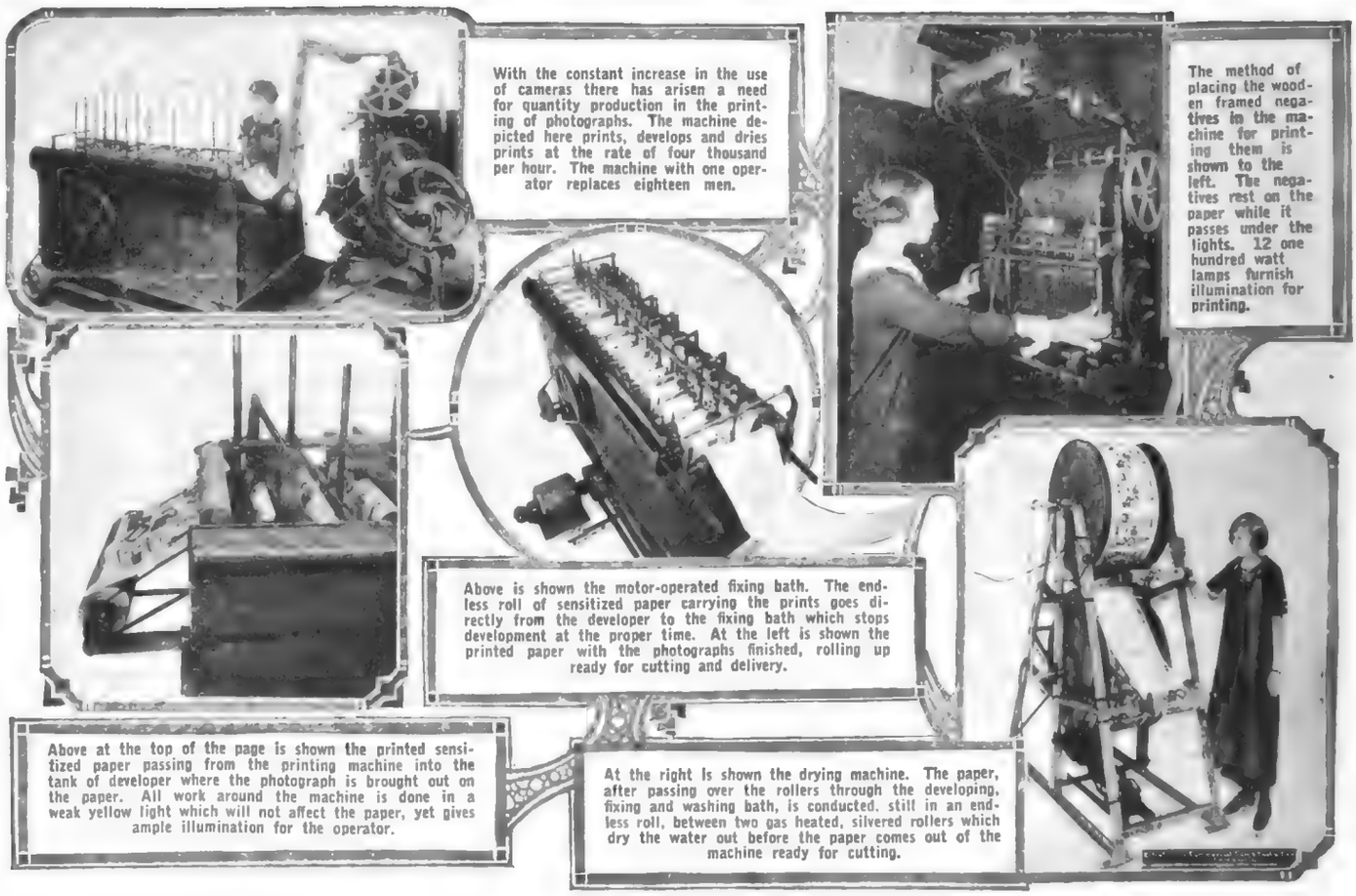
Quantity Photograph Printing

By A. N. MIRZAOFF



With the constant increase in the use of cameras there has arisen a need for quantity production in the printing of photographs. The machine depicted here prints, develops and dries prints at the rate of four thousand per hour. The machine with one operator replaces eighteen men.

The method of placing the wooden framed negatives in the machine for printing them is shown to the left. The negatives rest on the paper while it passes under the lights. 12 one hundred watt lamps furnish illumination for printing.

Above is shown the motor-operated fixing bath. The endless roll of sensitized paper carrying the prints goes directly from the developer to the fixing bath which stops development at the proper time. At the left is shown the printed paper with the photographs finished, rolling up ready for cutting and delivery.

Above at the top of the page is shown the printed sensitized paper passing from the printing machine into the tank of developer where the photograph is brought out on the paper. All work around the machine is done in a weak yellow light which will not affect the paper, yet gives ample illumination for the operator.

At the right is shown the drying machine. The paper, after passing over the rollers through the developing, fixing and washing bath, is conducted, still in an endless roll, between two gas heated, silvered rollers which dry the water out before the paper comes out of the machine ready for cutting.

Collapsible Boat for Campers

Wei[illegible] 100 pounds and packed in a case 12 by 18 inches when not in use th[illegible] e above photographs is capable of carrying three persons. It is built r[illegible] wood and is covered with heavy canvas to make it water-tight when opened for use. The boat may be knocked down or put together in less than ten minutes by a boy, without tools. The stern is fitted in such a way that a demountable motor may be attached to it. The oars are built in sections, the same as the remainder of the boat.

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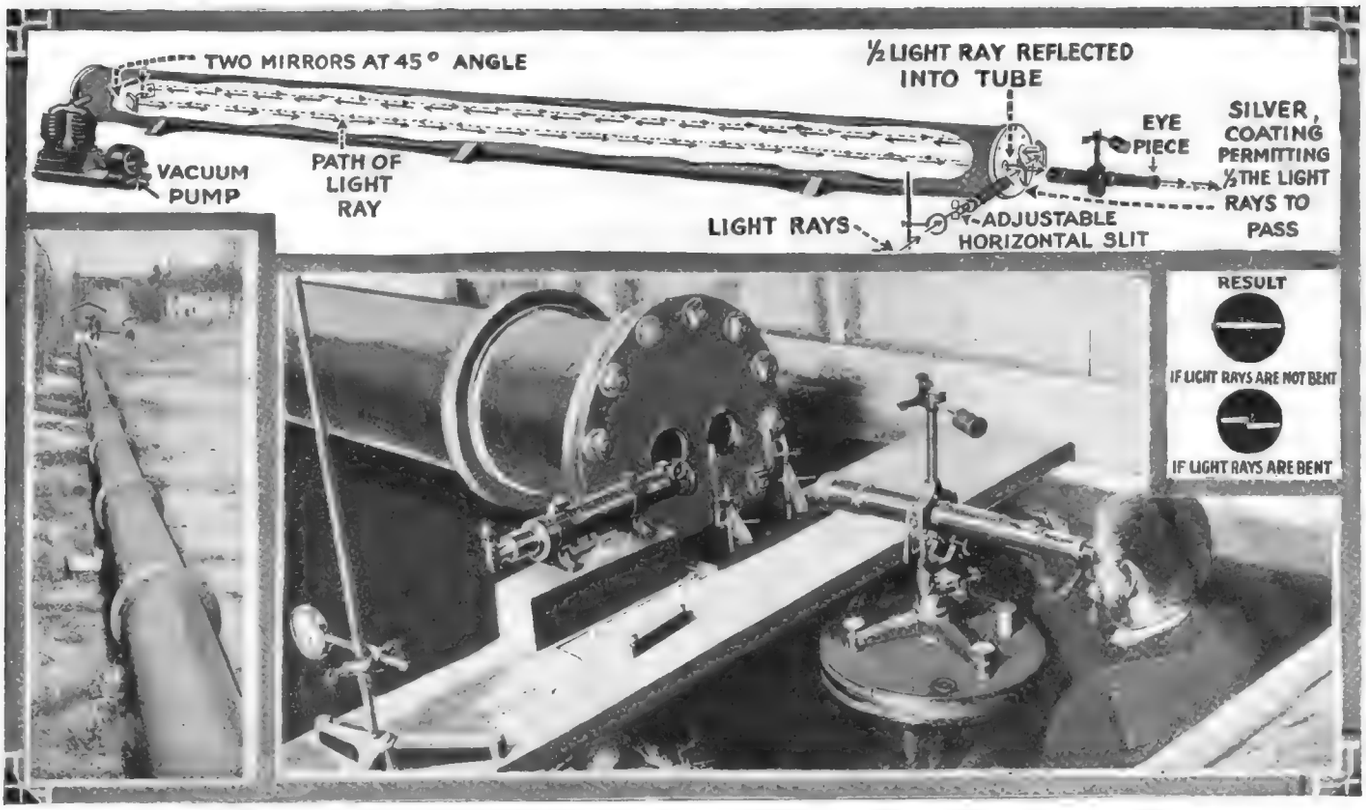
A Test of Einstein's Theory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Whether the ether immediately surrounding the earth is moved by the earth's motion like an air current set up around a revolving sphere or whether it is stationary as Einstein claims, is to be determined in a test soon to be made by Professor Albert A. Michelson, associated with Professor Henry Gordon Gale, at Chicago University. These professors are also going to ascertain by direct test to what extent, if any, light rays are bent in passing through the ether. For the test, a tube of cast iron piping sealed at both ends, lying flat on the ground, has been constructed. Attached to the tube is a vacuum pump to exhaust the tube. The light rays are gathered by the lens shown at the left, and are then passed through an adjustable horizontal slit (the collimator), which gives a parallel beam of light (or in other words, a straight line of light). This light strikes the first of two mirrors set side by side at an angle of 45° in the same direction, which are in line with two openings in the front of the tube. The first mirror has a thin silver coating and will permit but one-half of the light ray, which is in the form of a straight line, to be reflected into the tube. The other half passes through the first mirror and is reflected from the second mirror immediately in back of the first one. Both rays of light are again reflected by two 45° mirrors at the further end of the tube, and both are again collected at the eye-piece. If light rays are bent, the resulting beam observed at the eye-piece will not be straight, which it was when entering the exhausted chamber. If the rays are not bent, the resulting beam seen through the eye-piece will be straight.

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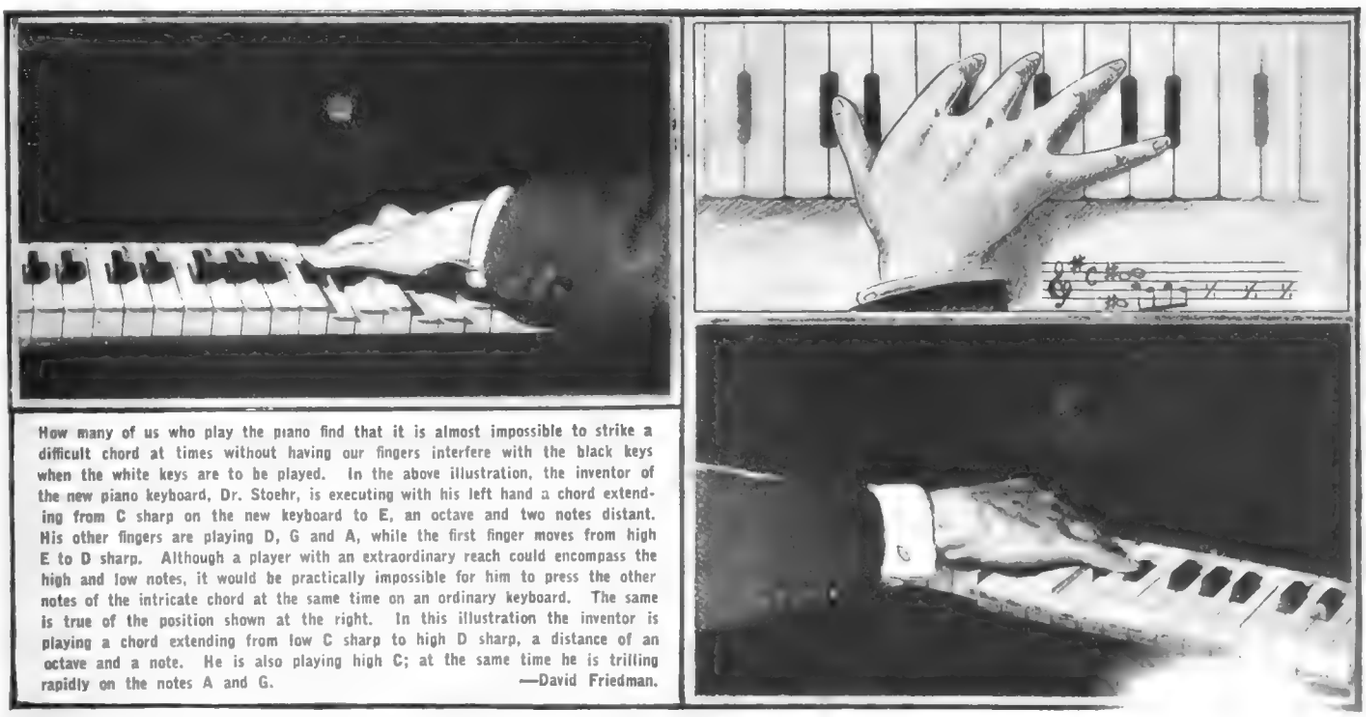
New Piano Keyboard Aids Player

Intricate Positions Now Mastered Easily.



How many of us who play the piano find that it is almost impossible to strike a difficult chord at times without having our fingers interfere with the black keys when the white keys are to be played. In the above illustration, the inventor of the new piano keyboard, Dr. Stoehr, is executing with his left hand a chord extending from C sharp on the new keyboard to E, an octave and two notes distant. His other fingers are playing D, G and A, while the first finger moves from high E to D sharp. Although a player with an extraordinary reach could encompass the high and low notes, it would be practically impossible for him to press the other notes of the intricate chord at the same time on an ordinary keyboard. The same is true of the position shown at the right. In this illustration the inventor is playing a chord extending from low C sharp to high D sharp, a distance of an octave and a note. He is also playing high C; at the same time he is trilling rapidly on the notes A and G.

—David Friedman.

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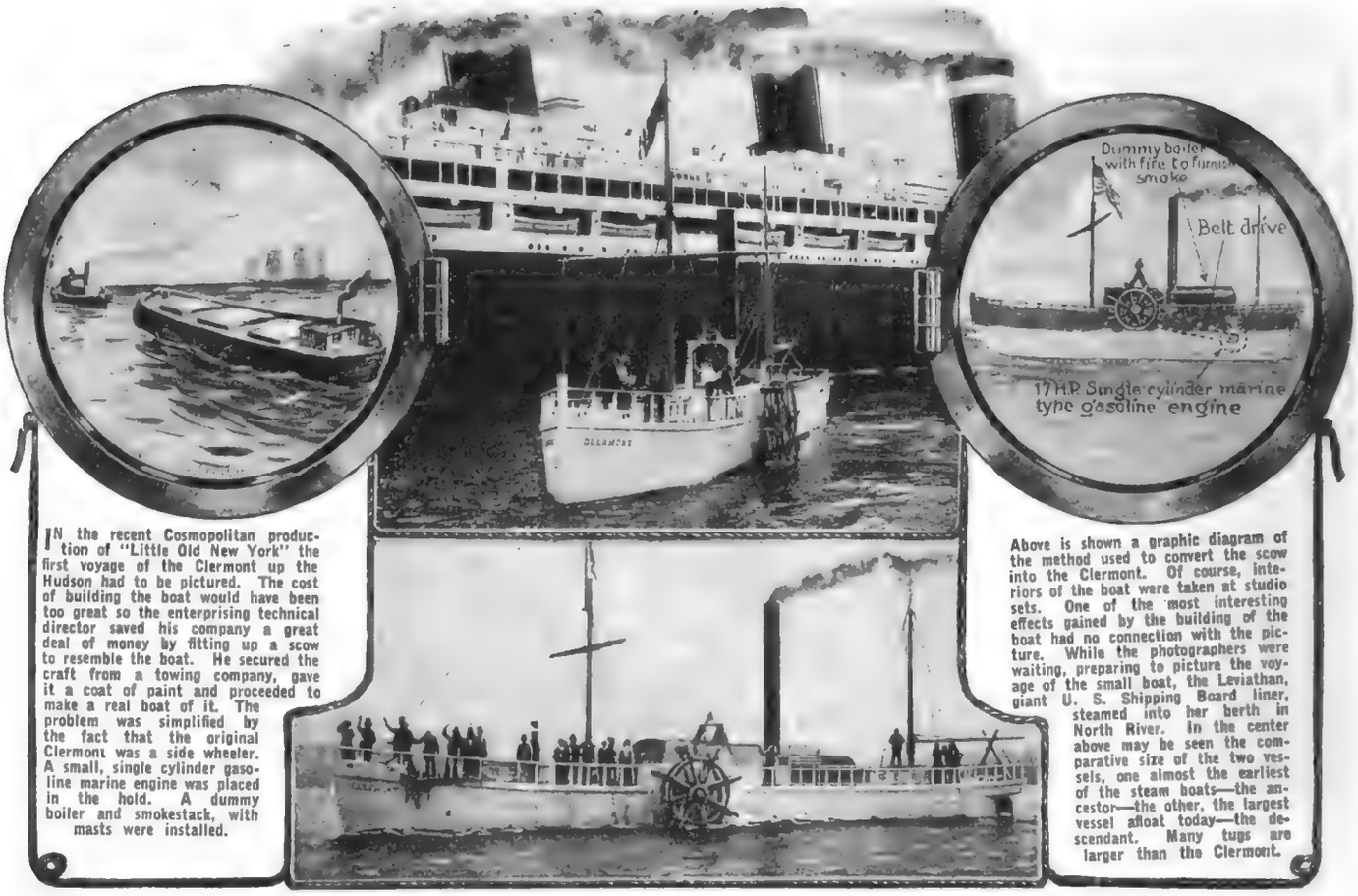
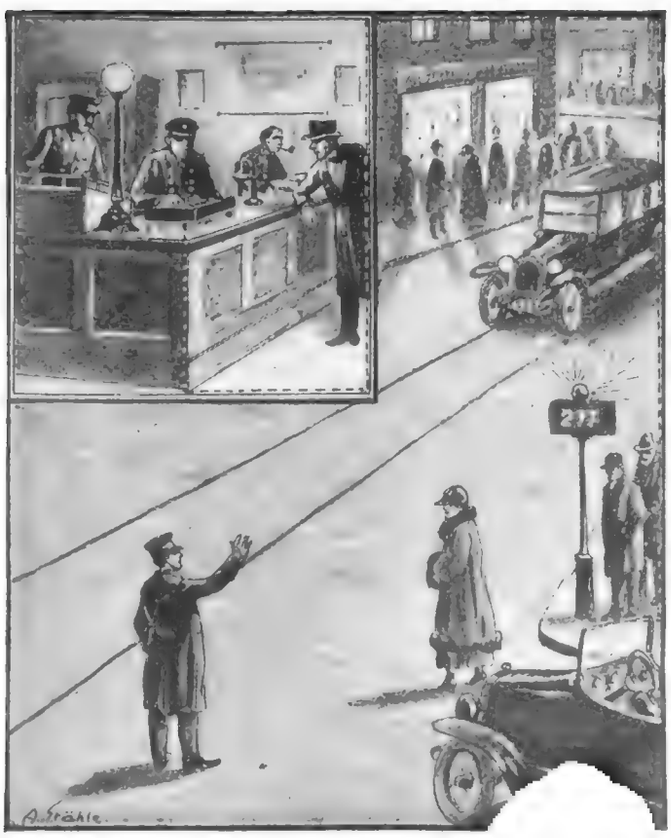
Replica of "Clermont" for Movies



IN the recent Cosmopolitan production of "Little Old New York" the first voyage of the Clermont up the Hudson had to be pictured. The cost of building the boat would have been too great so the enterprising technical director saved his company a great deal of money by fitting up a scow to resemble the boat. He secured the craft from a towing company, gave it a coat of paint and proceeded to make a real boat of it. The problem was simplified by the fact that the original Clermont was a side wheeler. A small, single cylinder gasoline marine engine was placed in the hold. A dummy boiler and smokestack, with masts were installed.

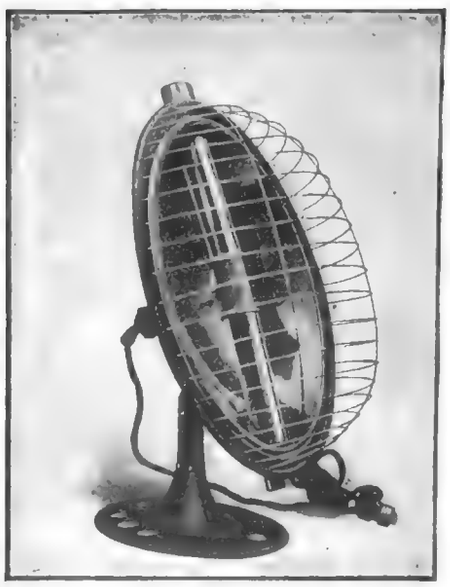
Above is shown a graphic diagram of the method used to convert the scow into the Clermont. Of course, interiors of the boat were taken at studio sets. One of the most interesting effects gained by the building of the boat had no connection with the picture. While the photographers were waiting, preparing to picture the voyage of the small boat, the Leviathan, giant U. S. Shipping Board liner, steamed into her berth in North River. In the center above may be seen the comparative size of the two vessels, one almost the earliest of the steam boats—the ancestor—the other, the largest vessel afloat today—the descendant. Many tugs are larger than the Clermont.

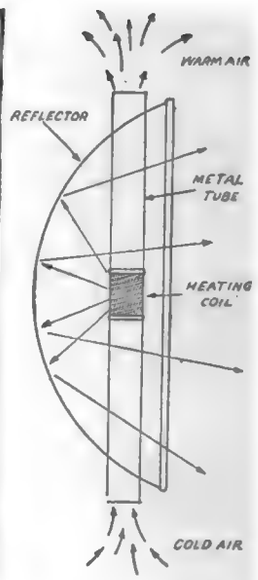
Universal Robbery Signal



The automobile is invariably the best means of escape for the hold-up man and the robber. For that reason, any method which will aid in making known the identity of the car used by the thieves will be effective in their capture. Above is shown a very practical method. A number flashing device, operated from police headquarters, is installed at all busy street intersections, thus enabling the license number of the fleeing car to be flashed to thousands of people. —W. J. White.

Efficient Electric Heater





Most of the electric heaters in use at the present time do not take advantage of one of the chief methods of dispersing heat through the atmosphere of the room being heated, viz., convection. The heater shown above circumvents this inefficiency by installing the heating unit in a flue, thus giving the heated air a constant path for its movement, thereby allowing the heater to spread its heat throughout the space to be heated instead of focusing it. —Dr. E. A. Martin.

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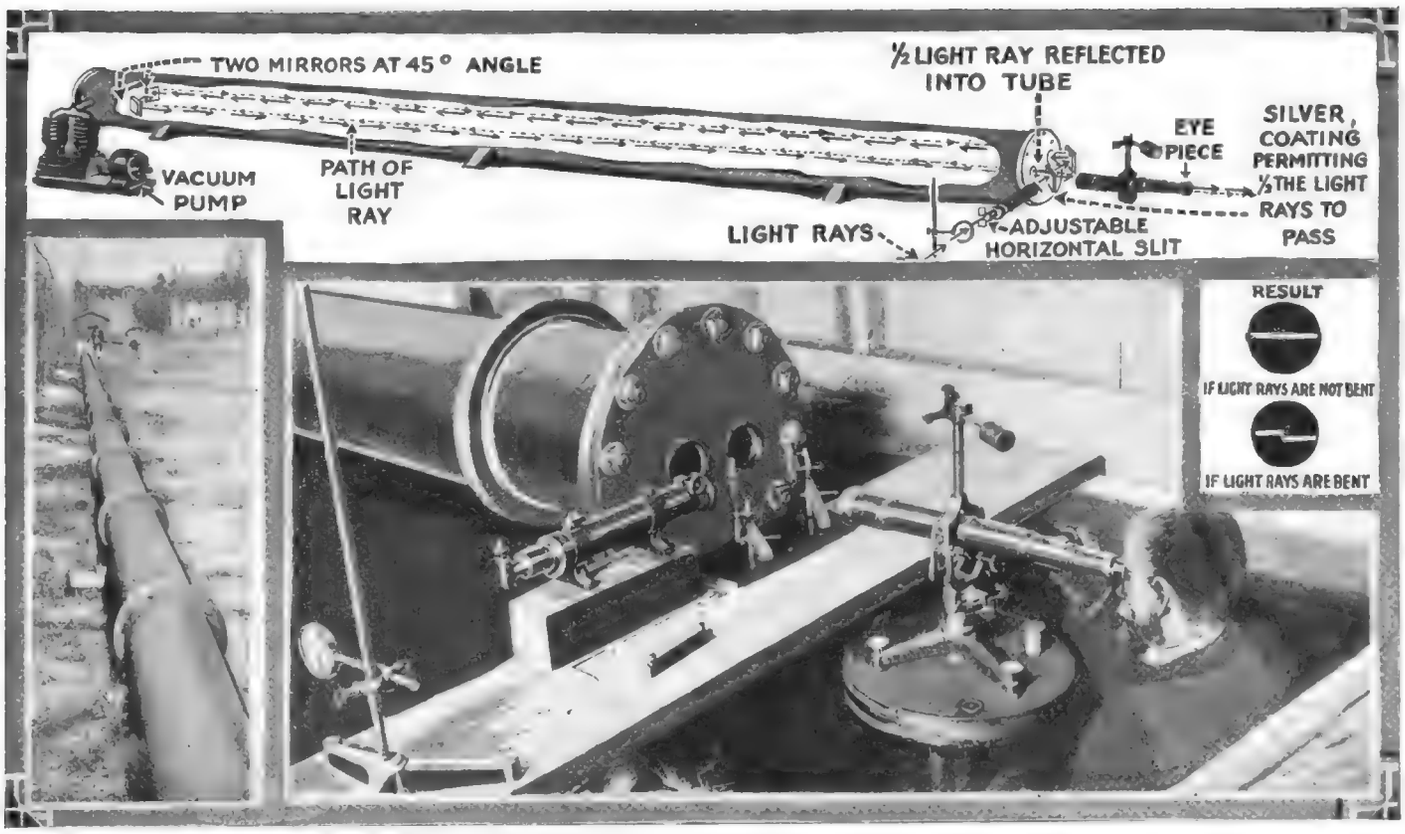
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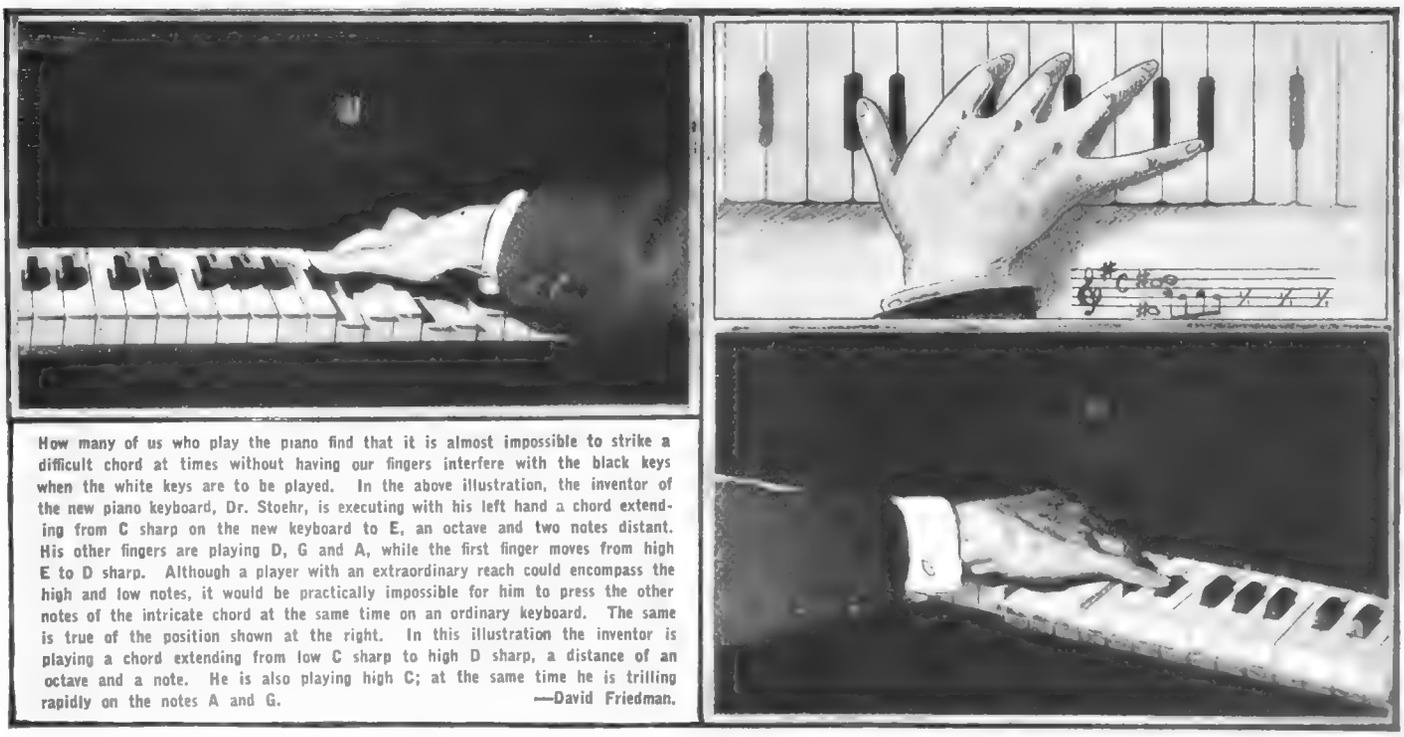

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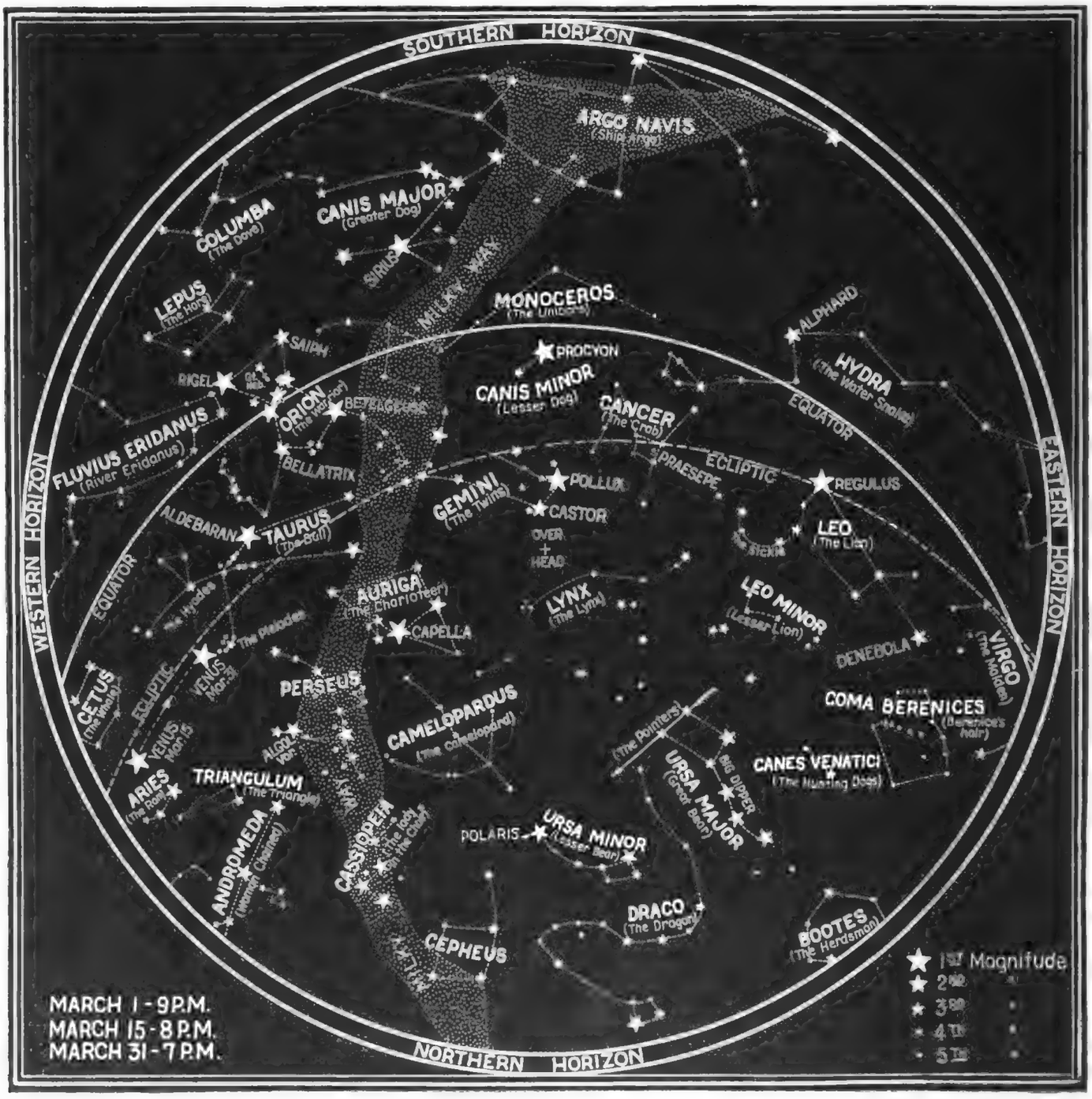
The Heavens in March

By ISABEL M. LEWIS, M.A.
of the U. S. Naval Observatory



Above is the star map for the month of March. If the chart is held over the head with the "Northern Horizon," north, at nine P. M., March first or eight P. M., March fifteenth the location of the stars in the heavens will coincide with their position on the map and can easily be found. The "overhead" location is indicated on the map.

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The long straggling constellation of Hydra is [illegible] conspicuously into view in the [illegible] contains no star of the first magnitude. Alphard or Cor Hydrae, Heart of the Serpent, a second magnitude star, however, stands in a solitary position in the southeast far from any other bright star. In its straggling nature and the faintness of its stars, as well as in its enormous extent—half of it is still below the horizon—this constellation of Hydra reminds us of Eridanus, the River Eridanus, now disappearing below the southwestern horizon.

Eridanus also contains but one conspicuous star, Achernar, meaning End-of-the-River, a star of the first magnitude which marks the end of this constellation. It is so far south that it is never seen here, but can be seen by southern tourists.

AT THE SOUTHERN HORIZON

On the southern horizon at this time we get a glimpse of the magnificent constellation of the southern hemisphere, Argo Navis, which contains in addition to Canopus, the second brightest star in the heavens, a number of stars of the second magnitude. To those who live in the mid-latitudes of the northern hemisphere all of these brilliant stars are invisible however.

In Argo Navis, as well as in Centaurus, another group of the southern hemisphere which contains Crux, the far-famed South-

(*Continued on page* 1164)

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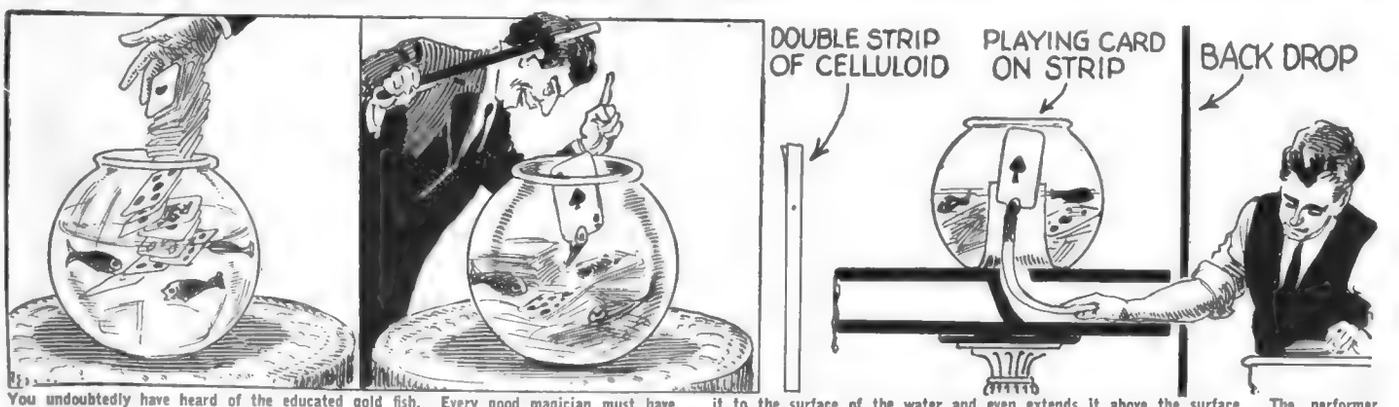
Magic for Everybody

By PROF. JOSEPH DUNNINGER

NO. 12 OF A SERIES

The above photographs show Professor Dunninger demonstrating his new phantom card mystery. (The professor is seen holding the cards). Effect: Two cards are placed on a glass plate, one facing upward and the other downward. The card with its face up is passed half way beneath the other, and then both turned over. The spectator believes he sees two different cards. One of the cards is now placed beneath the glass plate and with a quick movement brought up toward the plate. It has changed its suit. By pasting two cards with their faces together, and two with their backs together, this trick is easily performed. One must try it to obtain the effect.

The magician becomes an artist. A frame with a glass center plate is passed out for examination, and on being returned, is covered with a piece of thin drawing paper. A lamp in back of the easel throws its beams of light through the paper. The artist draws a picture of a southern beach upon the paper, and steps aside. Presently the entire scene becomes vividly colored. Due to the celluloid screen, the colors appear. This screen is painted and rolls up at one end of the frame on a small curtain roller. The magician merely draws it across the back of the drawing board in order to obtain the colors.



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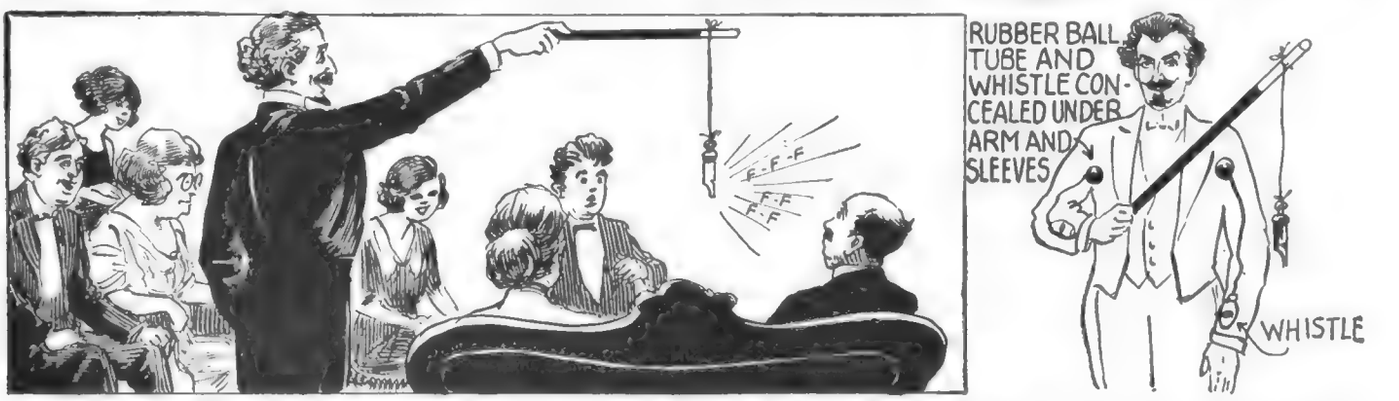

A whistle on the end of a string answers any question, by whistling once for "yes" and twice for "no." One never suspects that the performer has a whistle concealed in each arm while a rubber ball connecting with the whistle by means of a small tube, causes the whistle to sound. This trick goes over better than you would think.

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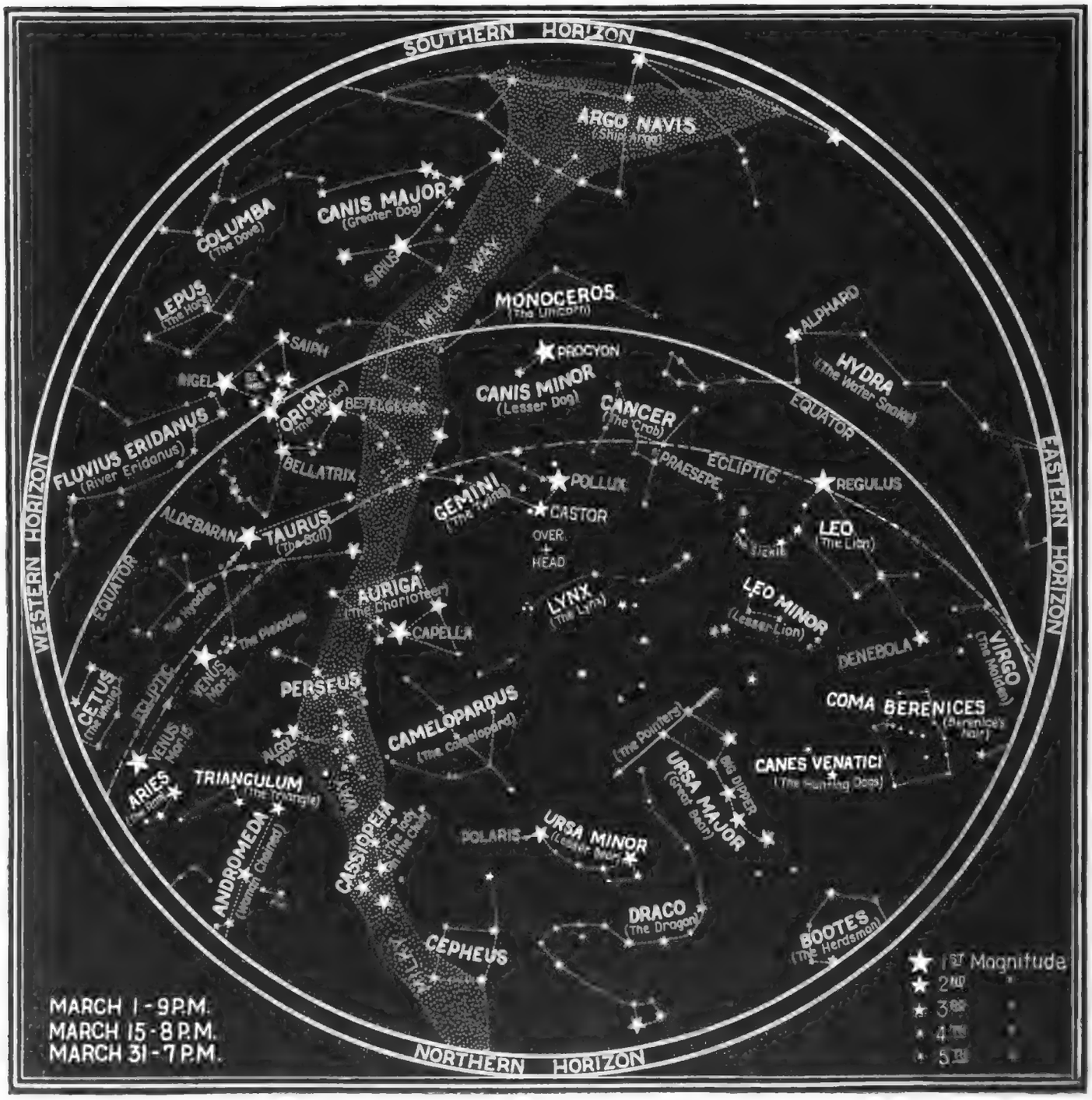

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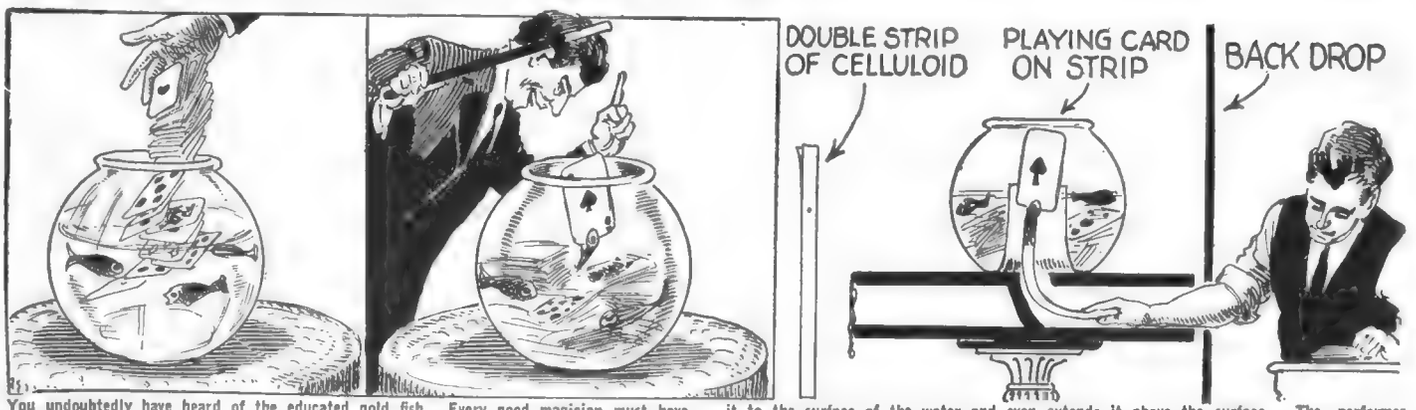
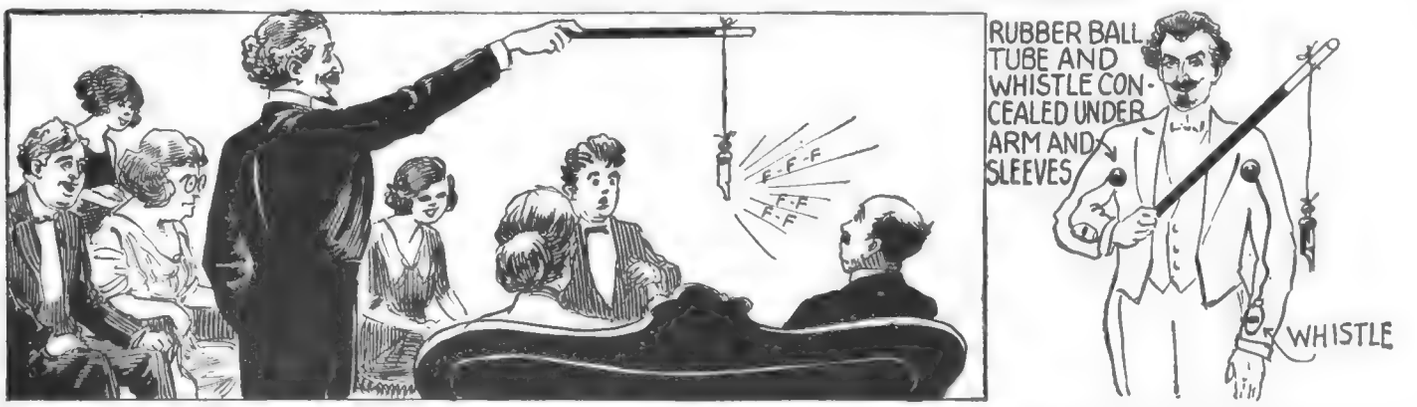


You undoubtedly have heard of the educated gold fish. Every good magician must have one of these. A deck of cards each and every one different, is thrown into the water of a gold fish globe in which three or four fishes are swimming. One of the audience calls for a card. Instantly the gold fish dips down, grasps the card in his mouth and carries it to the surface of the water and even extends it above the surface. The performer thanks the fish and calls for another card. Note that the gold fish globe is of peculiar construction and an assistant manipulates the imitation fish on the end of a celluloid strip. The cards are obtained from a duplicate set.



A whistle on the end of a string answers any question, by whistling once for "yes" and twice for "no." One never suspects that the performer has a whistle concealed in each arm while a rubber ball connecting with the whistle by means of a small tube, causes the whistle to sound. This trick goes over better than you would think.

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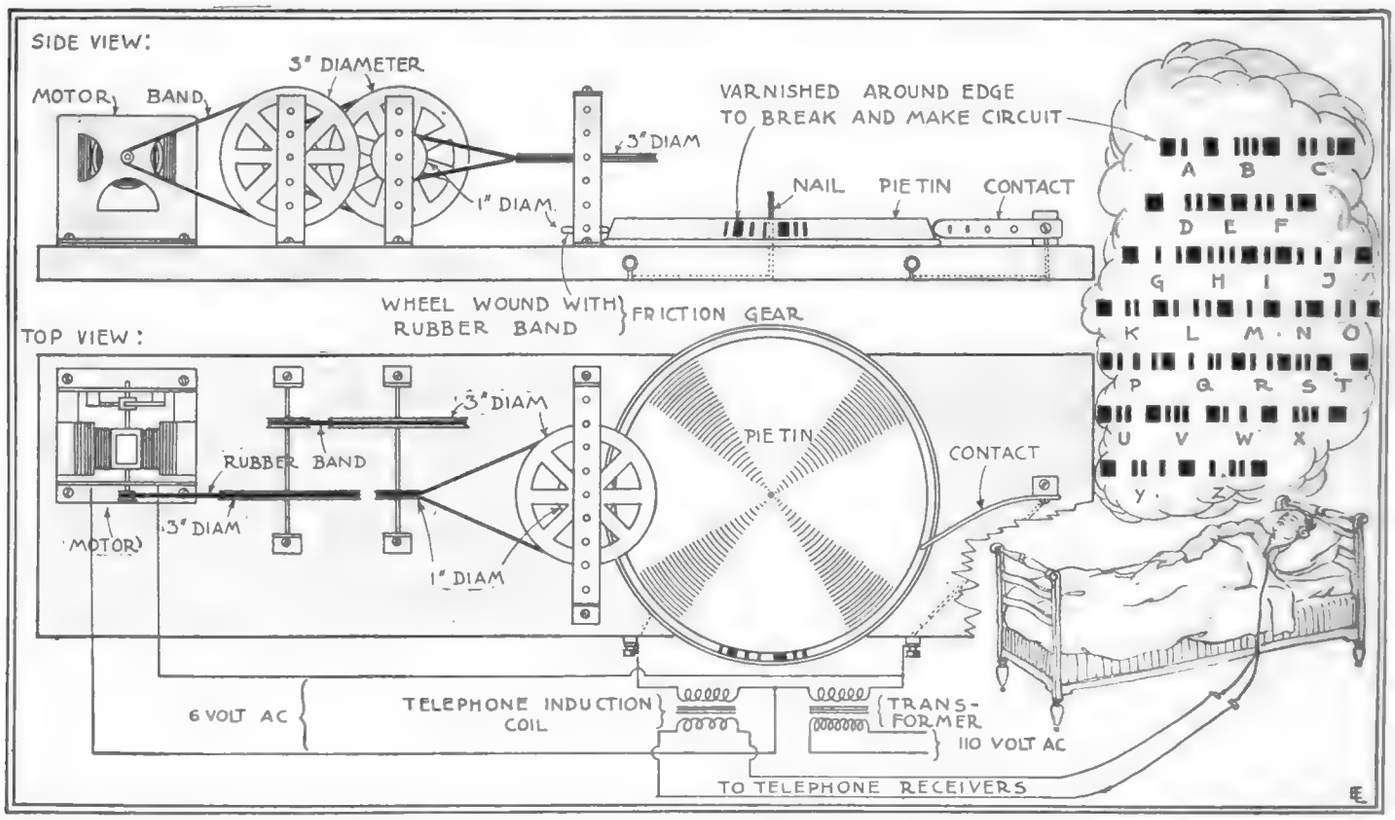
THE CONSTRUCTOR

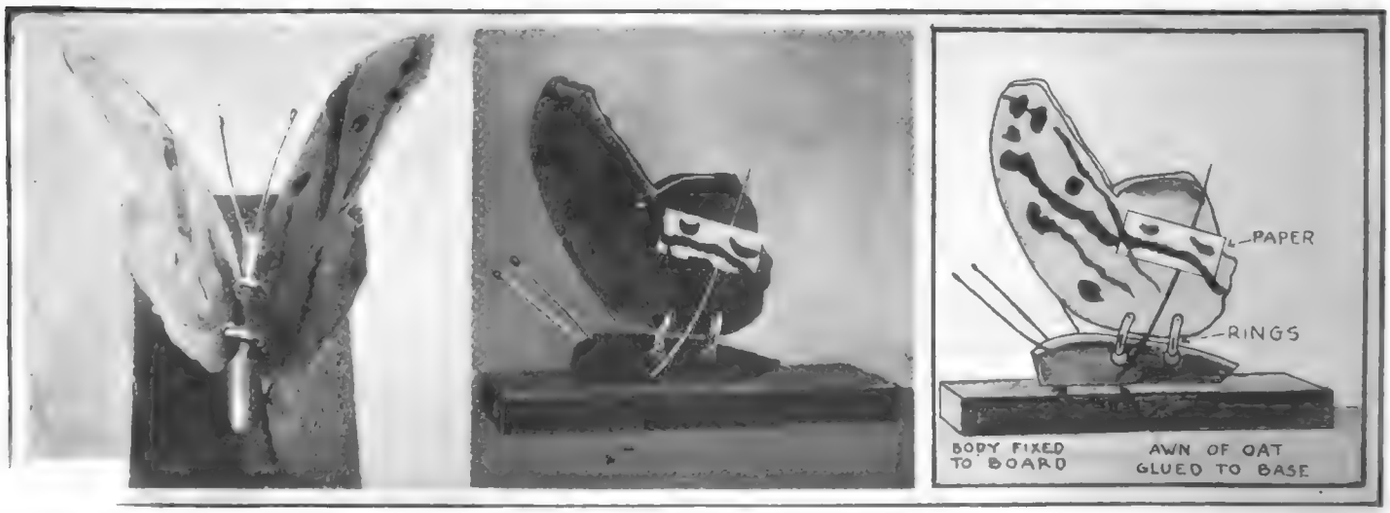
Subconscious Code Teacher

An Efficient Method of Learning the Code Cheaply



Following closely the idea used in the United States Navy which was taken from an article published in this magazine a few years ago, D. W. Hathaway, Reporter No. 1731, has devised the above plan. The edge of a pie tin is varnished and the code message is scratched into it. The tin is rotated by a small motor through a reducing system of pulleys. The method of mounting the various parts and the hook-up is plainly shown above. Hathaway states that with two nights use of the apparatus he was enabled to receive at the rate of five words a minute while before its use he hardly knew the alphabet.

Unique Weather Indicator



at is very sensitive to the presence of moisture in the air. Depending on effective as well as decorative weather indicator may be constructed as wo butterfly wings are fixed in small brass wire rings so that they move ly the rings are mounted on a block to resemble the body of a butterfly, as shown. Two oat awns are then fastened beneath the block and are brought up beside the wings to which they are attached. Care should be taken to see that one of the awns faces in one direction and the other in the other. For damp weather the wings are closed; they open for clear, dry days.

—S. L. Bastin.

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The Cause of Illusions

By M. GIRSDANSKY, M.D.

FIG 1

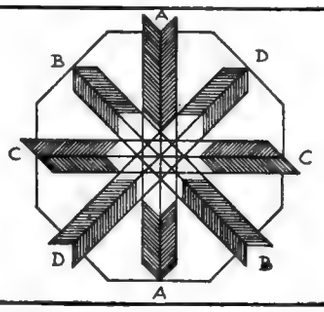


FIG 2

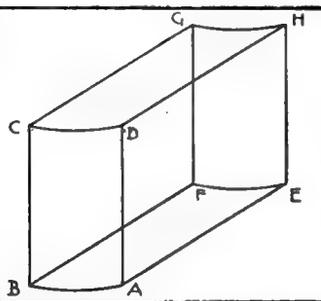
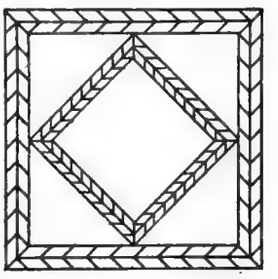


FIG 3



In the optical illusions shown on this page, we find that angle-illusion-figures reverse convexly or concavely near 150 or 170 in either direction. In Figs. 1 and 3 shown above composed by the artist G. Horowitz, the frames will be seen to alternate as convex and concave and remain so steadily, but when rotated around the center as a pivot, what was convex before becomes concave and vice versa, and they appear different to each eye. In Fig. 2 along the line G-H and A-B, the illusion changes from that of book lying book fashion, into that of a box with the top cover cut off. If viewed along the line B-H in Fig. 7 fashion, it will assume various positions as a square box with the top removed, or with its left hand wall removed, etc. These illusions may vary every five or six seconds with the fluctuation in blood pressure, which in this manner may effect the function of the neurons of the brain, thus effecting the understanding of the image. At least that is one theory.

FIG 4

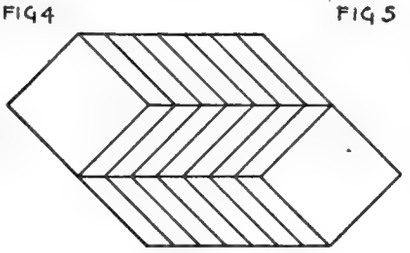


FIG 5

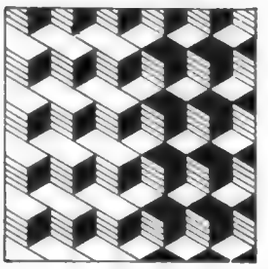


FIG 6

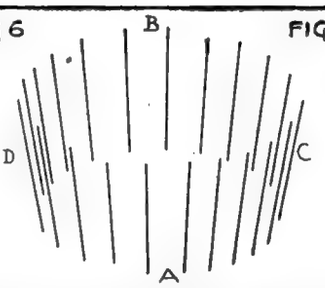
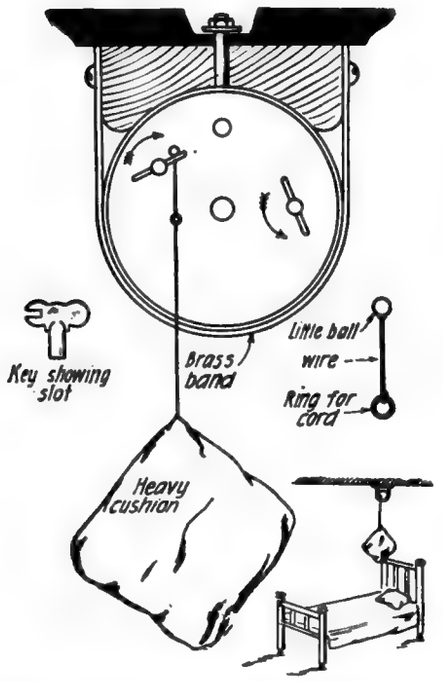


FIG 7

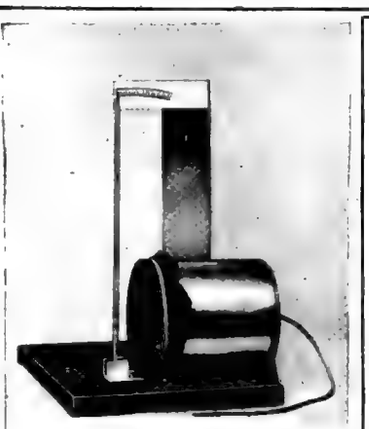
In Fig. 4 one angle seems convex and another concave. As one looks at the top or the bottom of the concave angle, it seems to waver between the two qualities. This is called an illusion, or in other words a "trick". The opinion held is that this is done by the brain which does not correctly represent the true image of the retina. Fig. 5 is very restless; truly shifting and "mocking"; the blocks now pointed in one direction will suddenly reverse. Fig. 6 viewed with one eye closed, as indicated at 7, shows the lines standing up (see "Psychology", by Professor R. S. Woodworth; and "Principles of Psychology", by Professor W. James). Horizontal lines can only be viewed in small parts at one time, while the vertical lines can be viewed entirely at one time. Hence the vertical lines as angles are seen as having the inner ends below and the far ends above the surface. Convexities and concavities remain so and change when the figures are rotated. All lines of black, white and spectrum colors singly or overlapping are clean cut. When horizontal and shaded they lose their identity. There is no "mocking" if one pupil is fixed upon any ang of Fig. 4. If the other angles are uncovered and indirectly seen, they force the eye, reflexly, to view them by a "jump" of the orbit. Persistence of vision of the former image is still prevailing, while a new one is thrown upon the retina. A pupil focussed upon any structure and protected from irritation by indirect rays from other incompatible structures, gives no illusion.

Alarm Kink

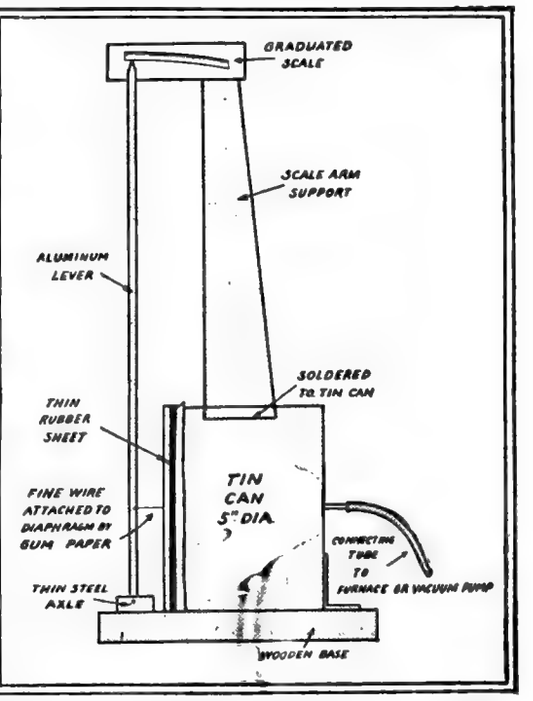


When the alarm on the old family alarm clock fails to awake the heavy sleeper here is a kink that will be effective. Slot the alarm key of the clock and suspend a heavy cushion from it as shown. The clock itself is suspended from the ceiling with the aid of a brass band and a block.

Sensitive Draft Gauge



There are usually two or three of the old time "U" tube draft gauges in the equipment of every boiler room. The reading on this variety of gauge is so coarse that they cannot be used where any degree of fineness is desired in measuring the draft. Where the vacuum must be measured with something approaching scientific exactness another type of gauge must be used. In the illustration above is shown an instrument that will show about three times the sensitiveness that is obtained with the old type.



The gauge shown above is easily made by stretching a thin pure rubber membrane over the mouth of a metallic cylinder. A tin can about five or six inches in diameter will serve very well for the cylinder. A hole and a small piece of brass pipe are attached to the back of the cylinder from which a rubber tube leads to the stack or fire box. The can a small arm is soldered to carry the graduated scale. The pointer is of aluminum and is faster by means of a small wire and a piece of gummed paper.

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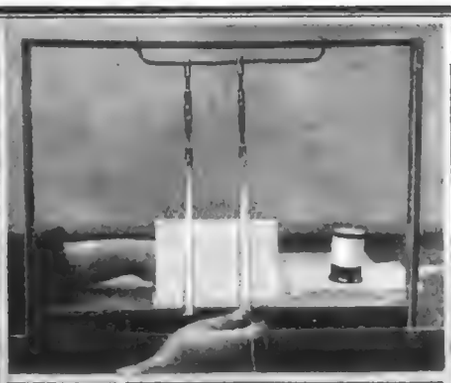
Easy Method of Book Binding

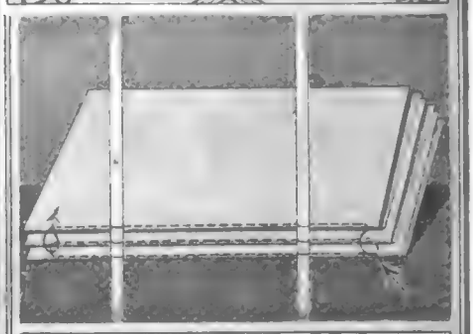
Process May Be Used for Permanently Binding Magazines

BY DR. ERNEST BADE

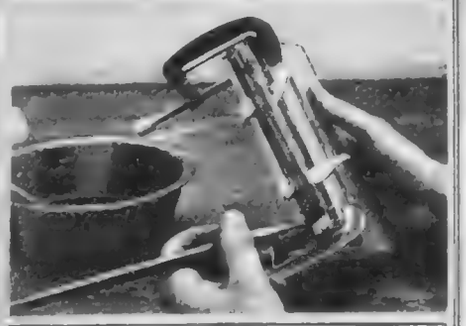
THE first step necessary is to collect the pages in signature form—that is, a certain number of pages folded in the middle. If a magazine is to be bound this will already be done and it will only be necessary to remove the wire stitching through the leaves. The stitches removed, several of these signatures will be found. A piece of decorative paper—heavy, preferably—is folded double so that the decorative sides face each other. This is then folded around the first and last signature as shown above so that it will be stitched in solid with the remainder of the book. This decorative paper forms the first leaf of the book and the inside of the cover.



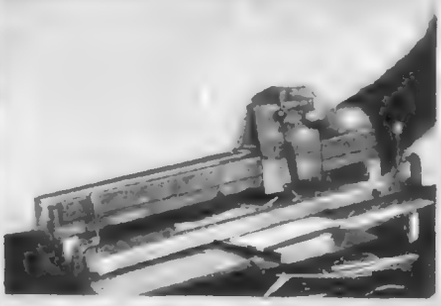
The next step is to stitch each of the signatures together and by the same means fasten them to two linen or cotton ribbons. The ribbons are suspended so they may be held taut and then, keeping the signatures in their proper order each one is stitched down the middle and to the ribbons as shown above. If a standard book is closely examined this stitching process can easily be seen. It is important that the ribbons be held taut while the leaves are being stitched to them in order that the completed book will hold closely together. In the above illustration this process is shown. The frame is used to hold the ribbons at the desired tension.



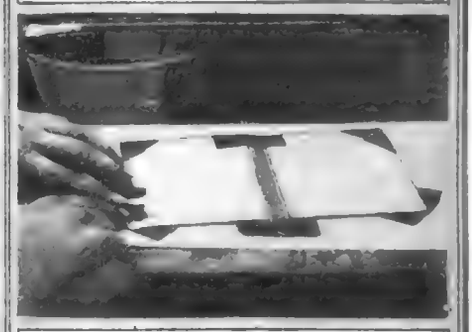
Above is shown a schematic diagram of the course followed by the thread as the leaves are stitched. By looping the thread from one set of pages to the next at each end, additional strength is given to the complete binding. The approximate position of the two ribbons is also shown in the sketch. All through this first process it is advisable to keep the leaves as near in line as possible. Some of them are sure to get out of place but a little care as the process progresses will prevent any great mistakes. This caution should be followed particularly if the book being bound is an old and especially valuable one.



With the stitching of the signatures complete, the next step is to place the complete binding with the ribbons between two stout bits of board and with the aid of a pair of carpenter's clamps press the binding as tight as possible. With it held firmly between the boards a heavy coat of carpenter's glue is placed on the back, seeing to it that the glue thoroughly covers the ends of all the forms as well as the ribbons. This coat is allowed to dry thoroughly. If there is any evidence that the glue has not thoroughly taken hold of all the forms another coat may be applied with good results.



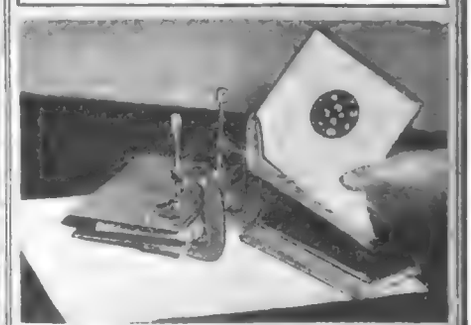
When the glue has dried thoroughly, the clamps are removed and the ends of the leaves are cut around three sides. This evens up the edges of the book. If no regular cutting machine is available one of the best processes to follow in cutting the leaves is to clamp the book to a board as shown in the above illustration, with the clamp along the line that is to be cut. A very sharp and stiff knife is used in the cutting. Soaping the blade will assist materially in obtaining a smooth cut. If the knife is placed on a block guide so that it will be held vertically at all times a neat job at this point will be assured.



With the binding complete the next process is the making of the cover. Two pieces of cardboard, slightly larger than the books are cut and laid on a piece of heavy cloth. This cloth should be large enough to allow ample margin on all sides of the two cardboard covers. In placing the cardboard on the cloth see that the center space is just properly distanced so that, with the book closed, the cover will fit it snugly. For the sake of wear it is best to place an extra piece of cloth at the corner and over the center as indicated by the dark portions in the above illustration. This will materially aid the wear of the completed book.

The binding is then set in place in the center of the cover and the ribbons laid out on the cover. These are fixed to the cover tightly with carpenter's glue. It is best to snap a light rubber band around the pages while performing this operation in order to keep the leaves in a bulk while working with them. This precaution will save a great amount of annoyance to the binder as the leaves, if not held by some means, will be continually falling down onto the glue and may possibly cause the whole job to be considerably messed up. The overlap of the cover cloth is then glued inside the back as shown.

With the leaves secured firmly to the back by means of the ribbons, the two decorative papers are glued to the inside of the covers forming the completed book. These decorative papers, being cut with the remainder of the leaves in step five, should fit the covers in such a way as to cover completely the cloth and corner overlap. If possible, they should be worked into place with the aid of a roller as this will materially aid in getting them placed perfectly flat onto the board and cloth avoiding air bubbles and wrinkles or spots on them. Great care should be taken at this step to get all the neatness possible.



After the completion of the book in the last step it is only necessary to place it in a clamp as shown above. Two boards should be used that will cover both backs of the book completely. Rather thick pieces should be used so that the pressure of the clamps will be carried to all parts of both covers. Then two other narrower boards are placed back next the binding and the clamps are put in place. This clamping process assures the straightness of the completed volume. If this step is left out, it is possible that the covers may bend out of place, causing the book to warp out of shape.

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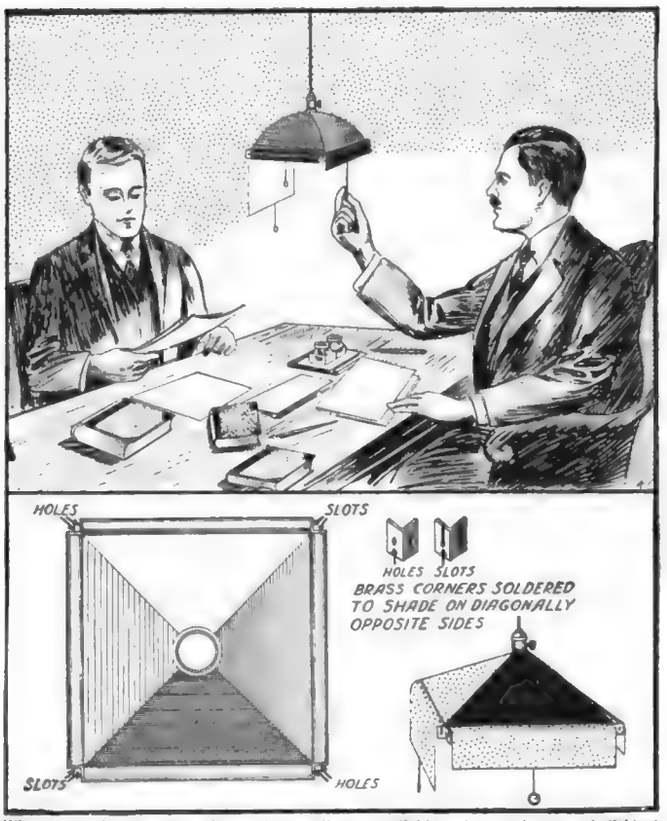
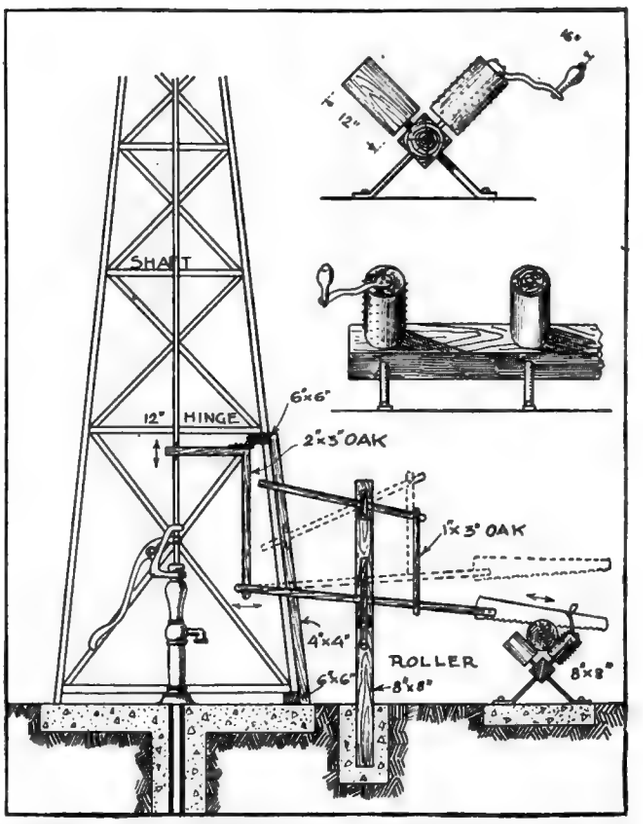
Lamp Shade Kink



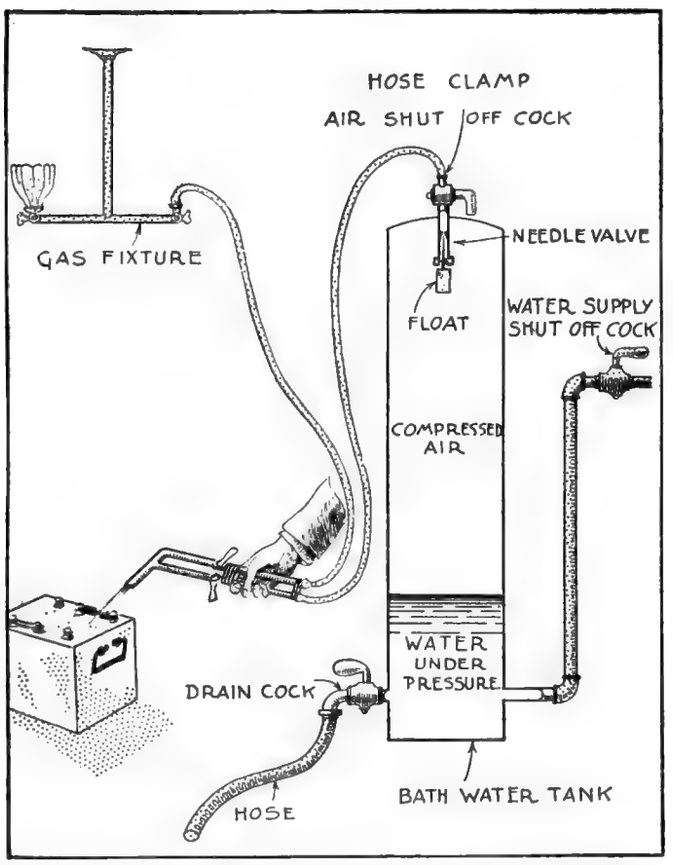
Where several persons are forced to use the same light each may have an individual shade by soldering small angles, cut as shown, to the corners of a square shade and installing curtains on rollers on each side of the large shade.
—V. Ciomei, Reporter No. 2997.

Wind Power Saw



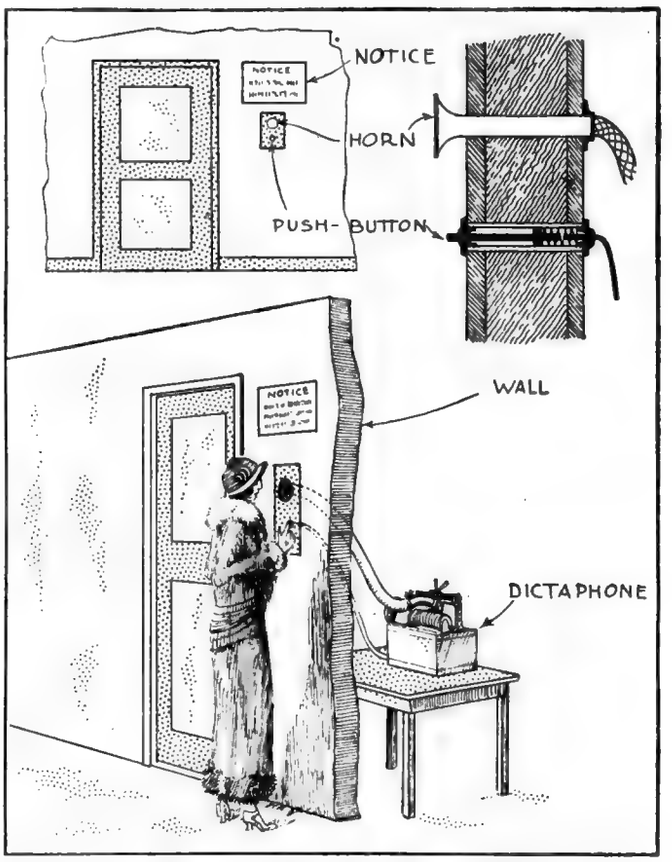
By attaching a system of levers, such as the one shown above, to a windmill and equipping the saw buck with rollers, an exceptionally handy wind-power saw is produced. A roller on the auxiliary post keeps the saw from falling to the ground.
—H. H. Siegele.

Illuminating Gas Torch



When the city water rises in the tank shown in the sketch air within is compressed so that, when used in connection with ordinary illuminating gas, a very hot flame results. The water runs all the time the torch is in operation. The float at the top prevents the water running into the air feed pipe.
—J. M. Galbraith.

Message-taker for Office



In offices whose occupants are frequently out, the above arrangement, making use of little more than a regular dictaphone, will be found exceptionally handy. The mouthpiece of the instrument extends through the wall with the starting and stopping button beneath it. The directions are on a placard above.
—H. H. Sie

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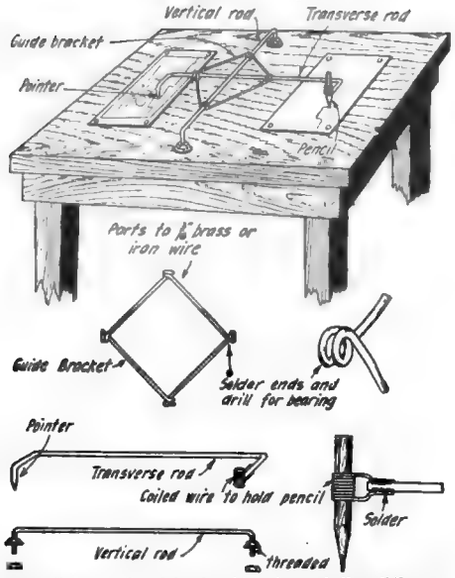
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

Drawing Tracer

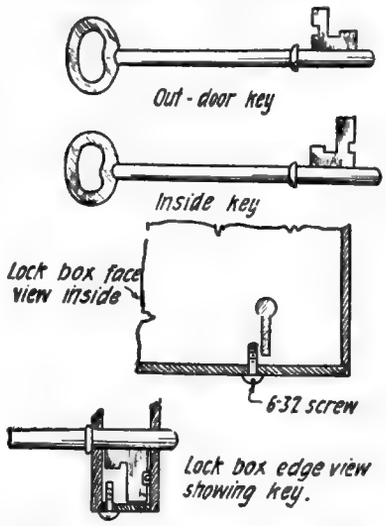
FIRST PRIZE $15



With the use of a lateral guide wire and the sliding arrangement shown in the above sketch a drawing may be traced from one sheet to another very easily.—G. A. Luers.

Safety Lock

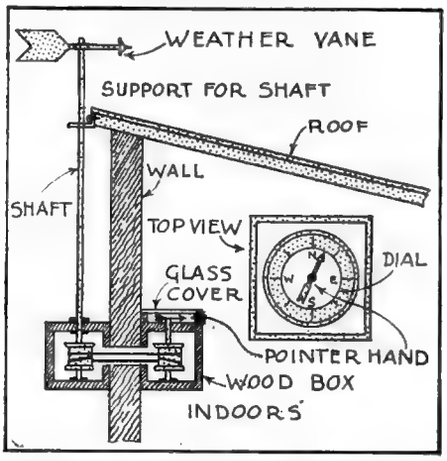
SECOND PRIZE $10



An ordinary lock may be made pass-key proof by inserting a small screw in the lock box as shown in the above illustration. Two keys will have to be used for this arrangement, one for operating the lock from the outside and the other for use when locking the door from the inside. The keys are notched as shown. —Jacob Raible.

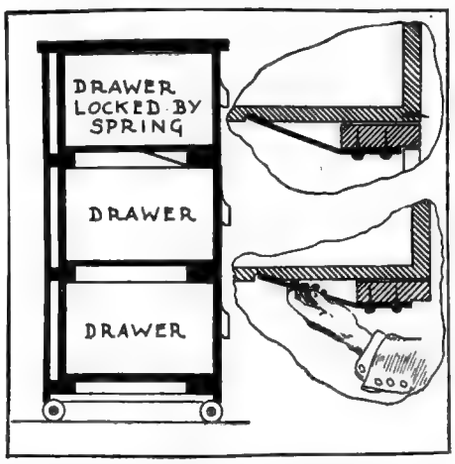
Weather Vane

THIRD PRIZE $5



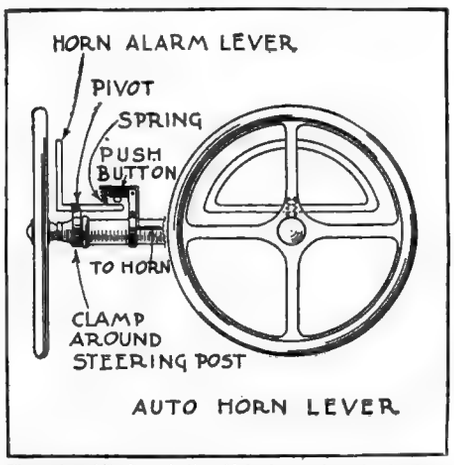
This mechanical indoor wind direction indicator is composed of a weather vane on a shaft, a pulley with belt extending through the wall of the house, a second pulley with shaft, a pointer and a dial. The parts are assembled in the fashion shown above. The pointer is fastened to the end of the shaft of the second pulley. The movement of the vane at the top of the house is communicated to the indicator by the belt. —Evermont Fisel.

Drawer Lock



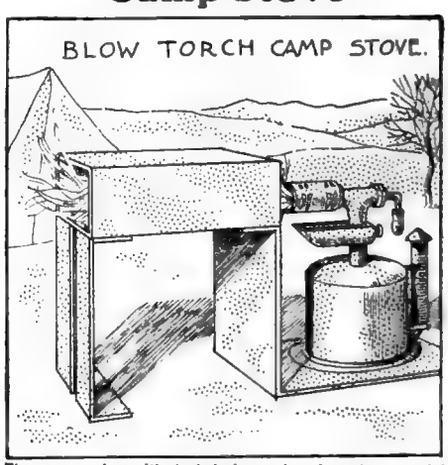
For locking one drawer of a chest a good system is to place a spring and notch as shown above. The drawer is unlocked from the one below it. —E. Joy Betterley.

Horn Button Kink



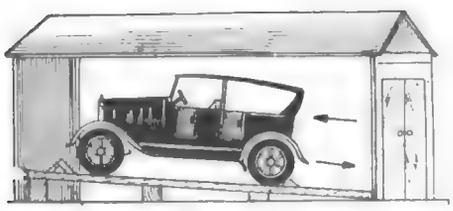
The automobile horn button kink shown above is simply an auxiliary button-pressing lever attached to the steering column in such a way that the horn may always be sounded. —Geo. Beane, Jr.

Camp Stove



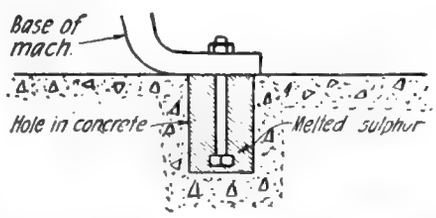
The camp stove illustrated is made of a large metal oven-like box into which is directed the flame of a blow torch. The metal box may be constructed so as to be collapsible. —Harold Jackson.

Garage Floor



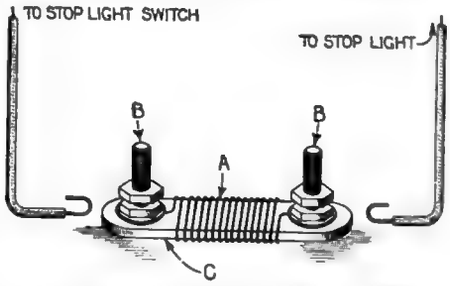
By tilting the floor of a garage as illustrated above the automobile may be run out by simply releasing the brakes in case of an emergency like fire. —R. C. Leibe.

Machine Base



Where concrete floors are laid and a new machine is to be installed upon it, placing the floor bolts in melted sulphur will save much trouble. —John Krebs, Jr.

Stop Light Resistance



A few turns of resistance wire wound on an insulator as shown will save many "Stop Lights." —M. A. Simon.

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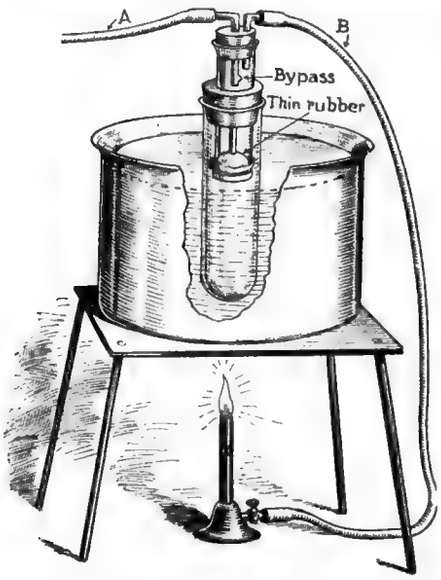
WRINKLES
RECIPES & FORMULAS

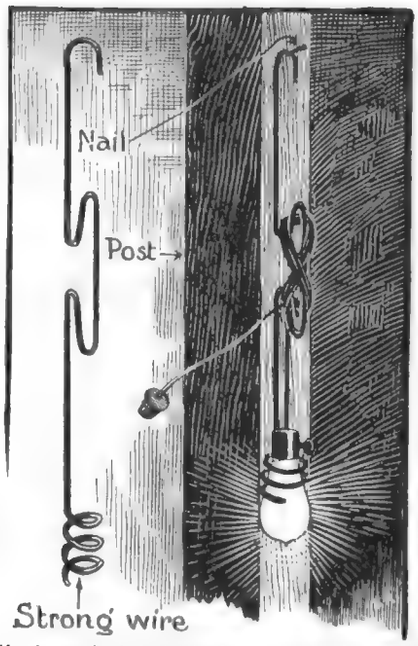
Edited by S. GERNSBACK

Chemical Thermostat



The thermostat as shown above may be constructed out of apparatus found in every experimenter's laboratory. After the desired temperature is reached in the solution the central tube is run down so that it just touches the thin rubber membrane. The by-bass keeps the burner lit. The membrane is fastened around the bottom of the cut test tube with wire or thread. —Harold Rowe.

Light Cord Rack

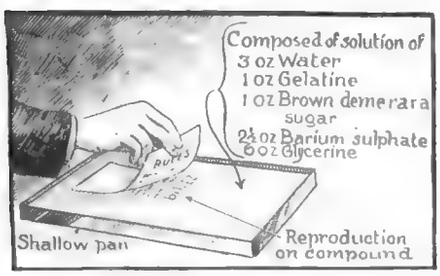


If a heavy wire is bent into the shape shown in the above illustration it will make the best sort of a holder for an extension light and cord. The coil at the bottom protects the lamp and socket. The bend keeps the cord straight. —Ethel Amine.

Ice Stunt

Ice melts by pressure. This may be proven in the following manner. Water is placed into a bicycle pump, the bottom of which has been plugged. A notch is cut into the piston washer to permit air to pass. The apparatus is now placed in a freezing mixture and the small quantity of water (one-quarter of the contents of the pump) is frozen so'id. A coin is placed upon the cake of ice thus formed and pressure of the pump piston is brought down upon the coin and ice cake. Repeating this several times and then removing the cake of ice, the coin will be found in the center of the block. Pressure of the piston on the surface of the ice melts the ice and permits the coin to drop. The water freezes again when pressure is released. —Dr. A. Neuburger.

Copying Compound

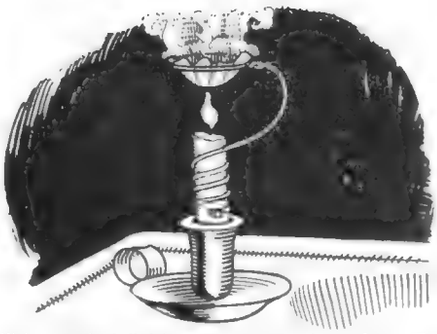


The compound listed in the illustration above is mixed and poured into a shallow cake pan where it is left to stand overnight. The result is a rubber-like mass. The copy is then written on highly glazed paper with Hectograph ink. The paper placed on the compound will leave an impression from which fifty copies may be made. —Ervin Seltzer. Reporter No. 557

Marked Tools

Here are two excellent methods for marking tools and glass: Cover the part to be marked with melted beeswax or hard tallow and scratch the desired markings in it. Cover with a little nitric acid if the part is metal. Use hydrofluoric acid if the piece is glass. —Cranston Coen

Paper Boiler

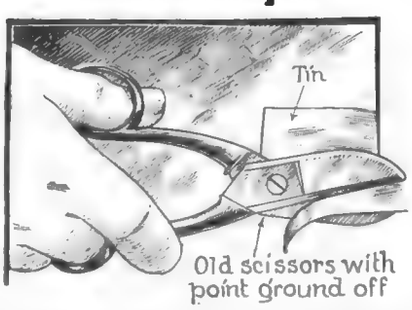


Water may be boiled in a paper cup as shown above. The water dissipates the heat so rapidly that the flame does not burn the paper in any way. —Ben Zyl.

Tape Kink

By scoring the sides of a roll of friction tape several times with a sharp knife the edge threads that tangle from one turn to the next will be prevented from doing so. —Raymond C. Kerlaouezo.

Tin Snips



If the blades of an old pair of scissors are broken off and the points ground down as shown in the above illustration a very good pair of small tin shears that will be very handy in dealing with thin metals will result. The rivet between the two blades should be tightened.—P. M. Enery.

Spook Message

Wet a piece of paper and place it on a mirror. Place a dry piece the same size on top of the wet one. Write a message in soft lead pencil. Dry the paper and the message disappears, wet it and it returns again. —Marshall

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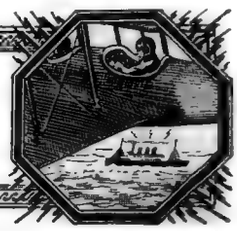
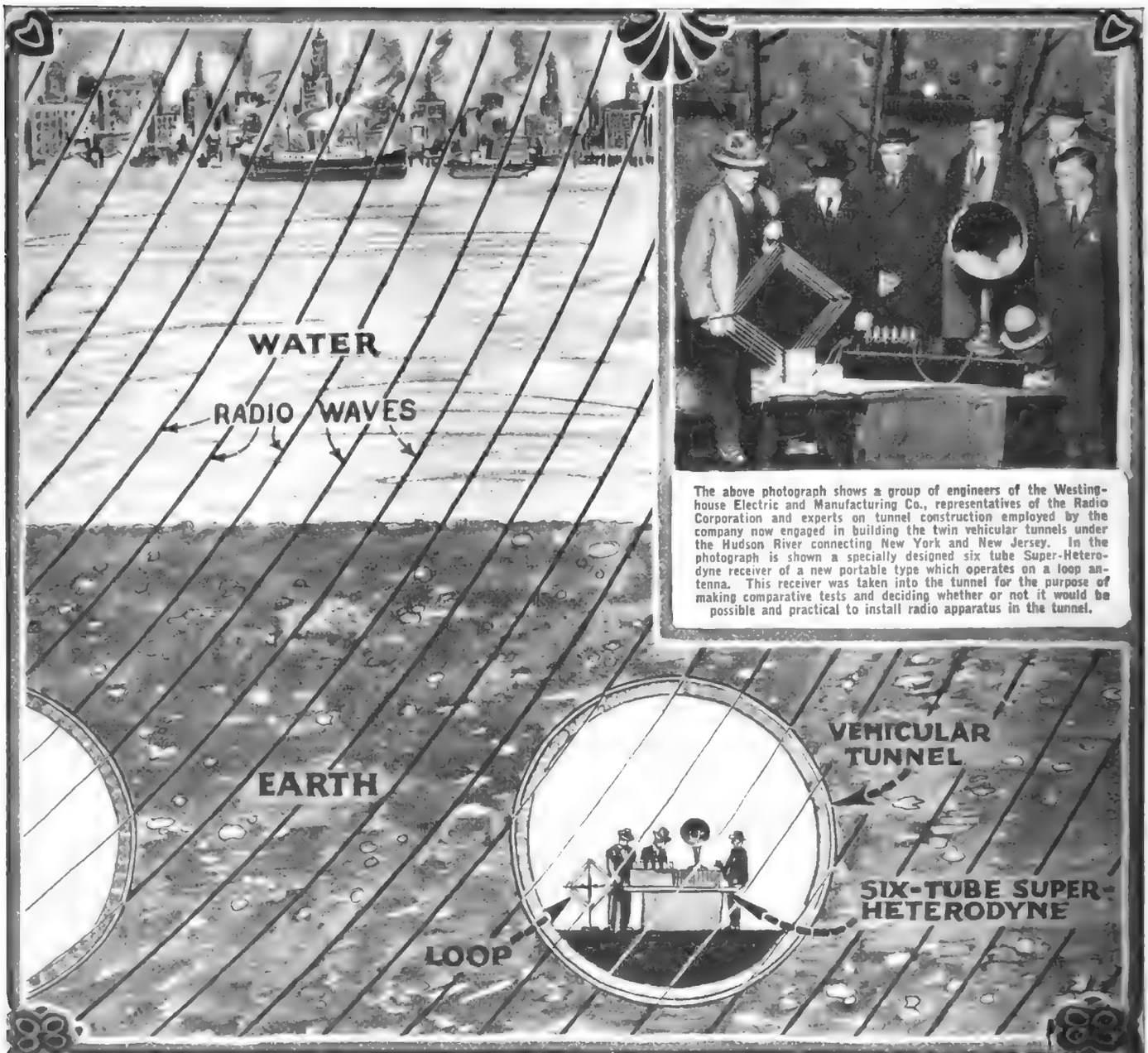
RADIO



Radio Waves Penetrate Tunnel

BY L. PORT



The above photograph shows a group of engineers of the Westinghouse Electric and Manufacturing Co., representatives of the Radio Corporation and experts on tunnel construction employed by the company now engaged in building the twin vehicular tunnels under the Hudson River connecting New York and New Jersey. In the photograph is shown a specially designed six tube Super-Heterodyne receiver of a new portable type which operates on a loop antenna. This receiver was taken into the tunnel for the purpose of making comparative tests and deciding whether or not it would be possible and practical to install radio apparatus in the tunnel.

For years the question of whether radio waves would penetrate to various distances below the surface of the earth has been a question open to experimental work. First, one group of investigators would come forth with the assertion that no results could be obtained and then other engineers would take up the proposition and report success. One of the most notable efforts in the direction of reception using an underground collective agency was that made by Dr. James Harris Rogers in connection with his now famous underground antenna. Excellent results were obtained with this type of collector. Some months ago in the pages of this magazine the results of tests made in subway trains were given.

During the month of January, a large eastern electrical manufacturing concern and an equally well known radio company promoted experiments which were conducted in the vehicular tunnel under the North River. These experiments proved conclusively that it was possible for radio waves easily to pene- [illegible] not only the water and earth surrounding the tunnel, but also the con- [illegible] steel walls of the tube itself.

[illegible] tests, concerts were received from broadcasting stations WOR, [illegible] and KDKA. The signals received were audible for 200 feet from the loud speaking receiver, being reproduced with great clarity and fidelity.

There are three hypotheses possible in connection with this work. They are that the waves penetrate to the tunnel as shown in our illustration above; that the waves enter the mouth of the tunnel and travel through it; and that currents are set up in the steel tube by the radio waves which are in effect re-radiated, affecting the loop receiver. In the opinion of one of the experts who assisted in conducting the tests, the first of these theories is the most acceptable and probably is the closest to the correct solution. Our illustration above shows how the radio waves penetrate approximately 50 feet of water and 40 feet of mud before they reached the tunnel. The signals are indicated as being somewhat weaker within the tunnel as this was one of the peculiar effects noted during the tests.

In order to disprove the theory of the radio waves entering the mouth of the tunnel, stations were received which were located in such a direction that the plane of the loop was parallel with the plane of the tunnel when the signals were loudest. That is, the loop was placed with its corners pointing towards opposite sides of the tunnel. In this position it was found that signals from certain stations were loudest.

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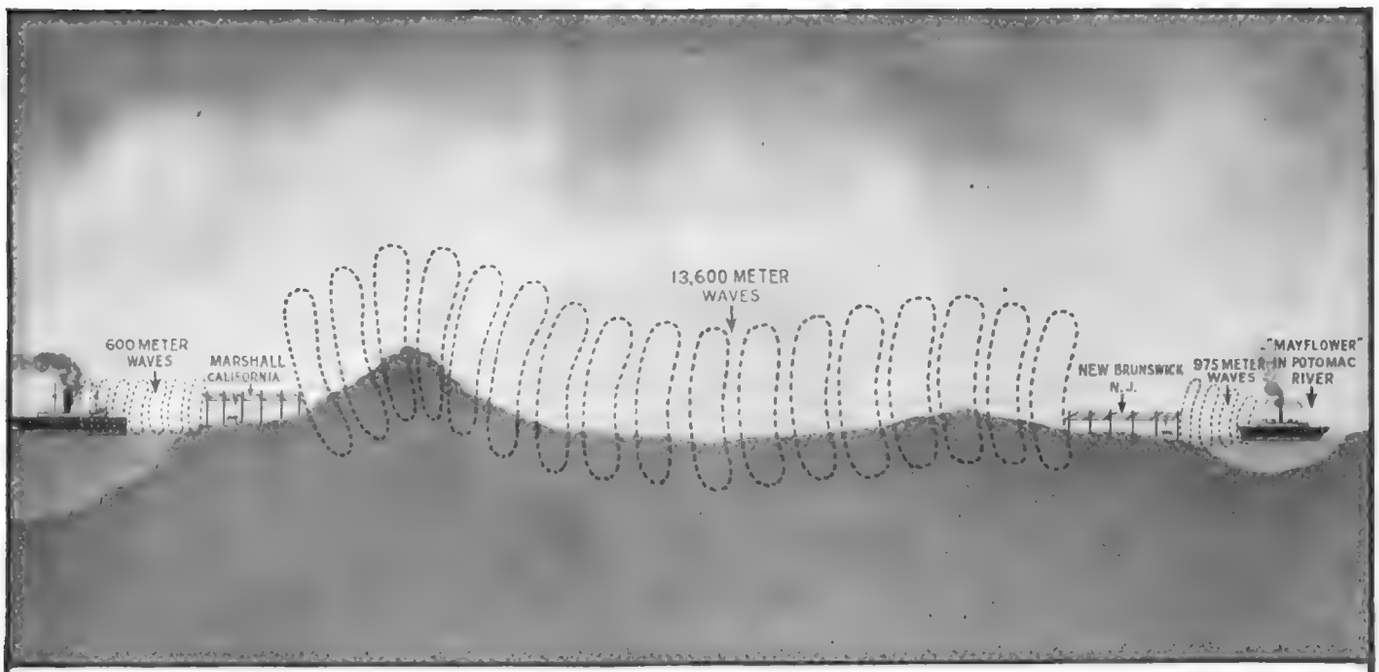
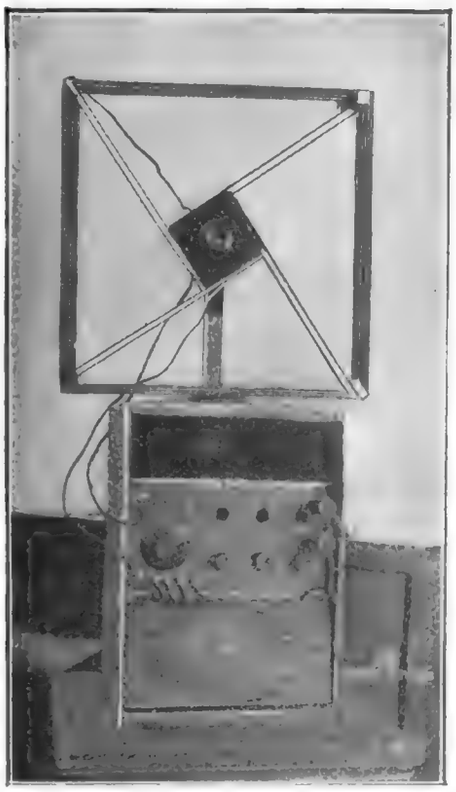
Trans-Continental Radio Control

Signal from Atlantic Coast Blows Whistle in Pacific



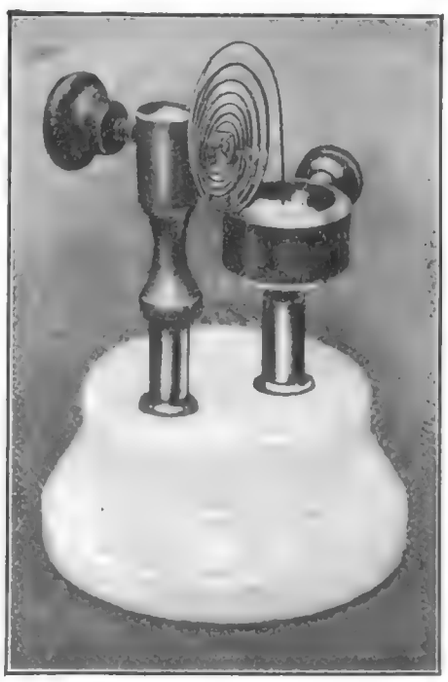
On January 5th a very successful experiment in long distance radio control took place in the United States. President Coolidge was on board the S. S. Mayflower in the Potomac River, just south of Washington. At exactly 8 P. M. he pressed the key controlling the radio transmitter on board the ship sending out a wave of 975 meters length. This wave was picked up by special apparatus at the Radio Corporation station in New York City. From there it was sent over a land line to W. I. I. located at New Brunswick, N. J. There the signal actuated instruments which in turn sent out another wave, this time on a wave-length of 13,600 meters. This signal, impelled by the tremendous power in use at W. I. I. crossed the continent and set up currents in the antenna of the Radio Corporation's high powered station at Marshall, California. Again the wave was transformed and sent out on a wave-length of 600 meters. Before it went out, however, the impulse received from New Brunswick was greatly amplified by means of vacuum tube amplifiers until it had sufficient energy to actuate the controlling mechanism of the short wave-length radio transmitter. This wave was picked up by the apparatus on the S. S. President Harrison in the Pacific. Here the signal was again amplified and it actuated a whistle through an electro-magnetic controlling device. The signal was flashed from coast to coast so quickly that before the President had lifted his finger from the key on board the Mayflower, the whistle on the President Harrison was in full blast. It is interesting to know that the high powered station at Marshall, California, was the first one to receive news from Japan of the earthquake which occurred there recently.

Small Receiver



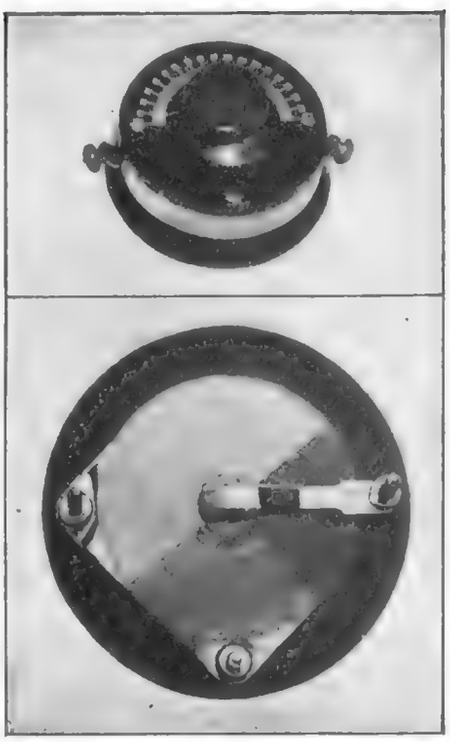
The set illustrated above is entirely self contained as it uses a loop antenna. Within the cabinet are three vacuum tubes and all the batteries. The entire apparatus measures 10 x 9 x 25 inches. —S. R. Winters

Novel Detector



A simple and very efficient crystal detector of French origin is illustrated above. One of the hair springs from a small clock is pressed into service to act as a cat whisker. One end of it is sharpened and the tension is regulated by means of the knob at the right. The character of the spring is such that a firm and even pressure is exerted on the mineral. This type of contact is particularly suitable for galena and other crystals requiring a light contact. —L. Fournier.

Mica Condenser



A new and compact type of German variable condenser has recently appeared on the market. It makes use of mica as a dielectric and, therefore, the plates can be placed closer together than in the air insulated type. The entire condenser is about three-quarters of [illegible] excluding the knob and it has a capaci[illegible]

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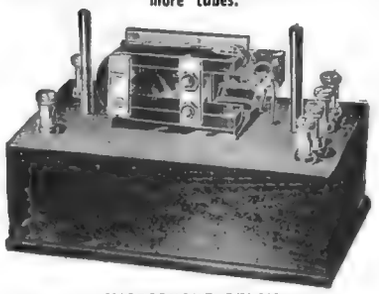
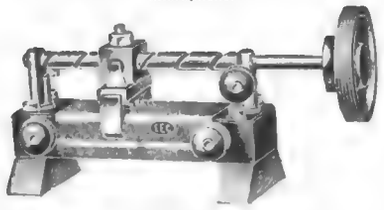
European Radio Ideas

Above: A novel design of a radio receiving set sold by a French concern. Note that the rheostats are mounted directly on the same supports that hold the tubes. Although we admire the French for their skillful workmanship and finely finished parts, still we cannot see why they always place the vacuum tubes on the top of the cabinet, fully exposed. A careless sweep of the arm or a dropped pair of pliers means disaster to one or more tubes.



MICROPHONE RELAY

The instrument illustrated above is the Brown microphonic relay which takes the place of two stages of audio frequency V. T. amplification and makes possible the operation of a loud speaker on a crystal detector receiving set. The cost of this instrument is slightly higher than a two stage V. T. amplifier, but it has practically no upkeep other than the purchase of two or three dry cells occasionally. Very little current is drawn from them, however, as they only serve to actuate the microphone.



RHEOSTAT

Above: An excellent type of precision rheostat. This instrument is of the wire wound type and contact is made by means of a sliding arm. This arm is actuated by a spiral cut groove which, because of its large pitch, causes the arm to travel the entire length of the resistance coil in a very short time. This instrument is very well made and will withstand the knocks usually given such parts in experimental work.

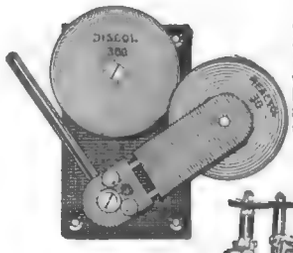
HONEYCOMB COILS.

Another type of honeycomb coil mounting in which the coils are designed to be placed either horizontally or perpendicularly. The center coil is stationary, while the other two are to be moved by the insulating extension arms.

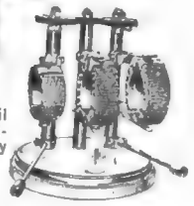
The photograph above shows a novel type of radio receiving set of English manufacture. The metal box is provided with a hinged cover which comes down over the set and fully protects it.

COMPACT SET

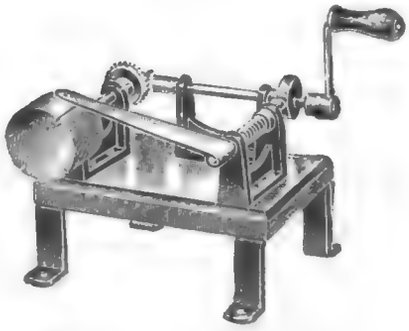
A French set of a compact type is shown above. The inductive relation between the primary and secondary coils is varied by moving the right hand end of the box, which is on hinges.



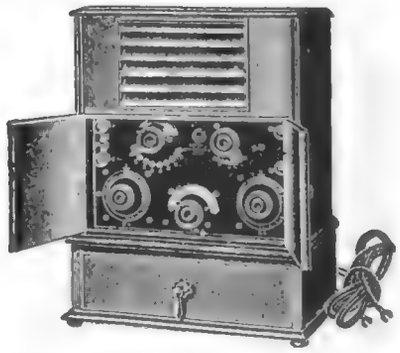
Left: Disk type inductance coils which may be used as a variometer or vario-coupler.



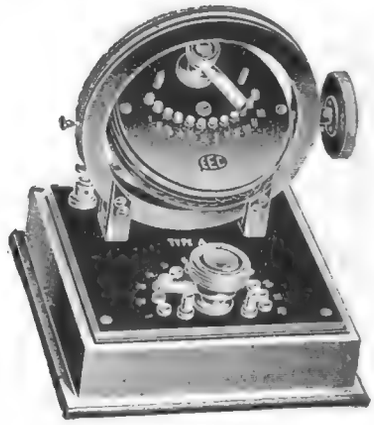
Right: A honeycomb coil mounting. The two outside coils are moved by the extension arms.



Automatic coil winding machine designed to wind coils of the duo-lateral or the honeycomb type. This instrument sells for quite a low figure and is the height of simplicity. No complicated parts are used with such an apparatus.

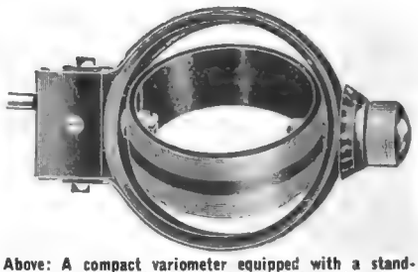


Above is shown a neat and compact type of English receiving set. The loud speaker is contained at the top and is concealed behind the lattice work. A drawer is provided for tools, spare tubes and parts. Doors are provided which cover the entire panel.

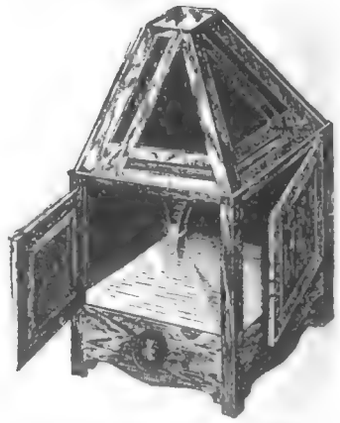


ENGLISH VARIO-COUPLER

One of the neatest types of vario-couplers which we have seen in a long time is illustrated above. It is of English make and gives very efficient results. Both the rotor and stator are tapped, the switch for the latter being mounted on the base. The rotor switch is mounted directly on the side of the rotor itself. The inductive relationship is controlled by the knob at the right.



Above: A compact variometer equipped with a standard honeycomb coil plug and designed to be placed in a honeycomb coil mounting. This instrument is particularly adaptable to experimental work.



A cabinet for containing a receiving set and loud speaker unit is illustrated above. The sound issues from the sides which are covered with cloth similar to a familiar American phonograph.

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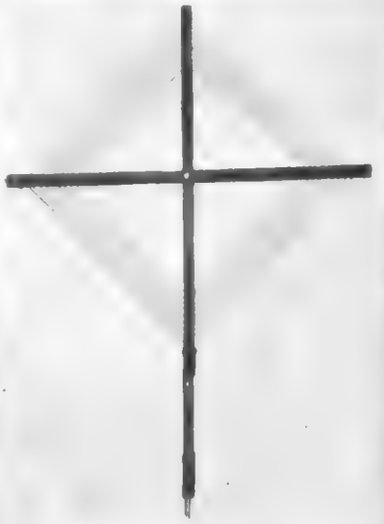
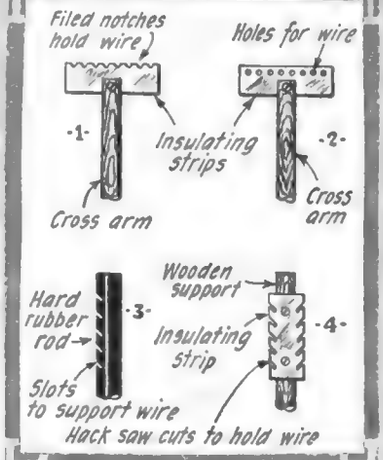
Practical Loop Antenna Construction

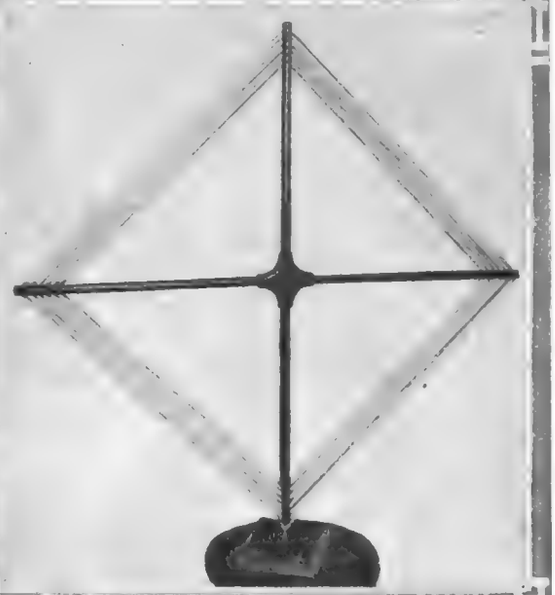
By JACK MILLIGRAM



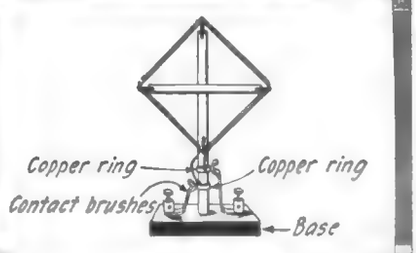
An ordinary phone plug is mounted on the end of the rod supporting the loop and the two connections from the winding are made thereto. A standard jack is mounted in the top of the receiving set cabinet. Placing the plug in the jack forms a support for the aerial.



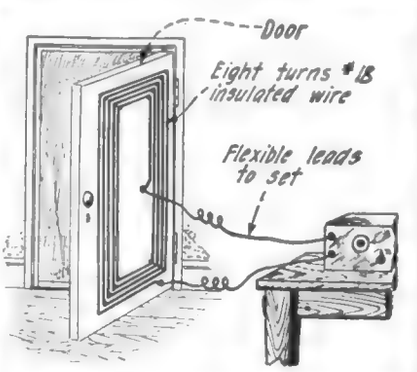
Above are shown several methods for supporting the wire in loop aerials. Figs. 1 and 2 show how notches or holes may be used, while Figs. 3 and 4 illustrate methods for holding the wire in the spiral type of loop.



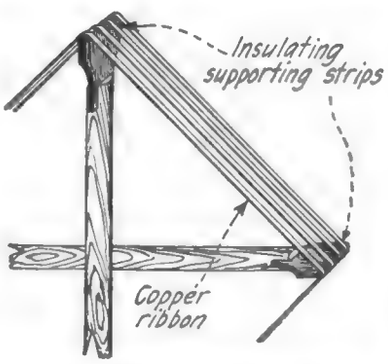
The wire on the above loop is supported by the method shown at 3 in the top center illustration. The mounting of this loop consists of two copper rings on the base of the supporting arm which makes contact with two springs located in the base. The loop can be readily removed.



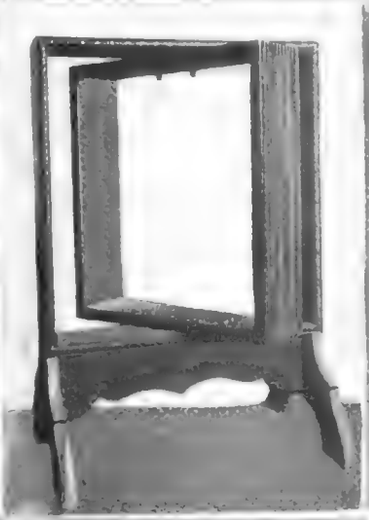
Two copper rings are mounted on the supporting rod and are connected to the two ends of the winding in the loop. Spring brass brushes are mounted on the base so that they make contact with the two rings. Connections are made to the binding posts.



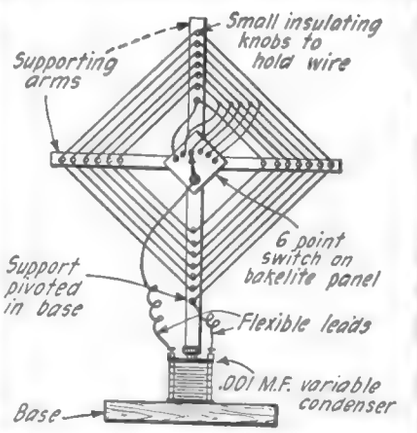
A door located in proximity to a radio receiving set is always a potential mounting for a loop aerial. Rubber headed tacks or glass "push-pins" may be placed in the door at intervals as indicated above and 6 or 8 turns of wire wound as shown. Flexible leads are then brought from the ends of the winding to binding posts on the receiving set.



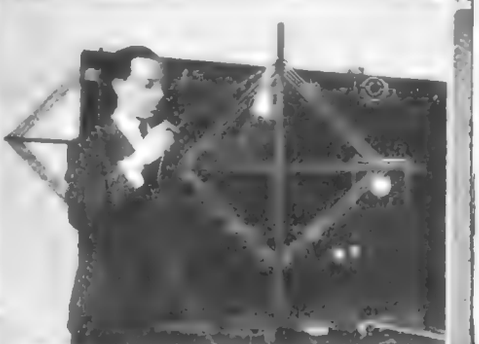
Because of the great surface which it presents for the conduction of radio frequency currents, copper ribbon, either of the solid or braided type makes a very efficient winding for a loop antenna. This may be supported on insulating strips mounted as illustrated. A flat file may be used for filing indentations in the supporting strips.



An excellent decorative type of loop antenna and supporting frame is illustrated above. The loop is wound on a square frame, stranded insulated wire being used. Connections are made to binding posts located in the upper part of the loop frame.



Sometimes it is desired to combine the loop antenna and the tuning condenser used in parallel with it so that only the vacuum tube apparatus need be contained in the cabinet. Further flexibility is given to the tuning by mounting a 6 point switch on a small insulating panel at the intersection of the loop arms connecting as shown.



The writer is shown above winding one of the many types of loops used in experimental work in the laboratories of this magazine. The frame-work of the loop is notched at points along each supporting arm so that the wire may be wound therein and supported in a fairly rigid

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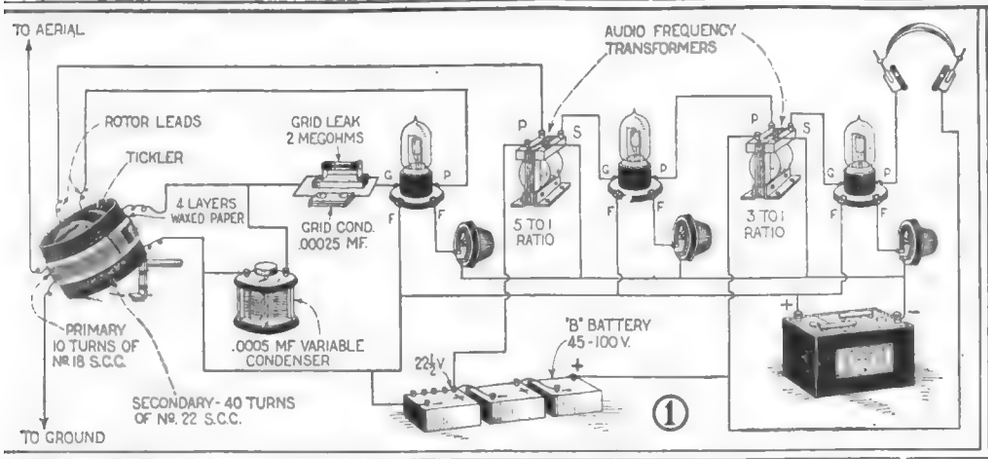
Methods to Stop Radiation

By A. P. PECK, Associate Member,



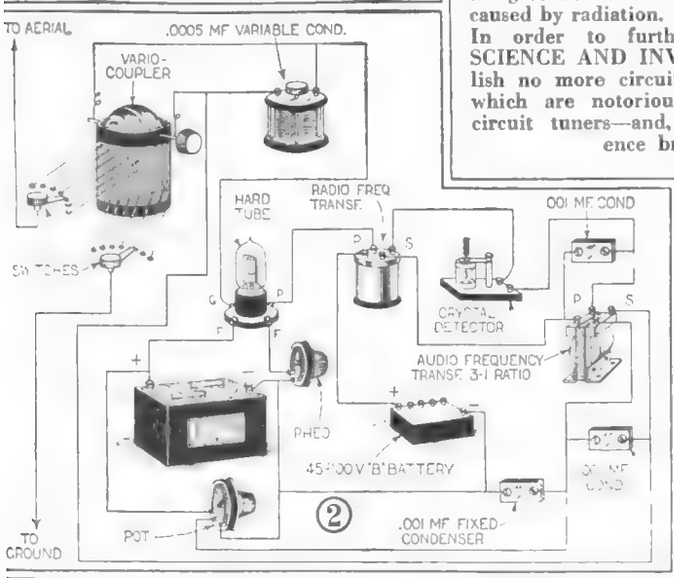
For the benefit of those interested in reducing the interference caused by their receiving sets we show at the left a circuit diagram of an excellent receiving set employing an untuned primary circuit. This circuit, because of the step-down effect found between the secondary and primary, reduces the radiation of the apparatus considerably. The remainder of the circuit aside from the primary, is similar to that of an ordinary single circuit tuner, one of, if not the greatest disturbers of the radio peace of this country. The only addition to a single circuit tuner necessary in order to make it a very selective and quiet receiver is a primary consisting of 10 turns of wire, wound directly over the stator coil. If it is of too large a size, it may be rewound following the data given here. Any standard tubes may be used in this circuit for both detector and amplifiers. If at first it does not function properly, reverse the connections to the tickler coil. It may also be found advantageous on some wave-lengths to connect a by-pass condenser across the primary of the first audio transformer.

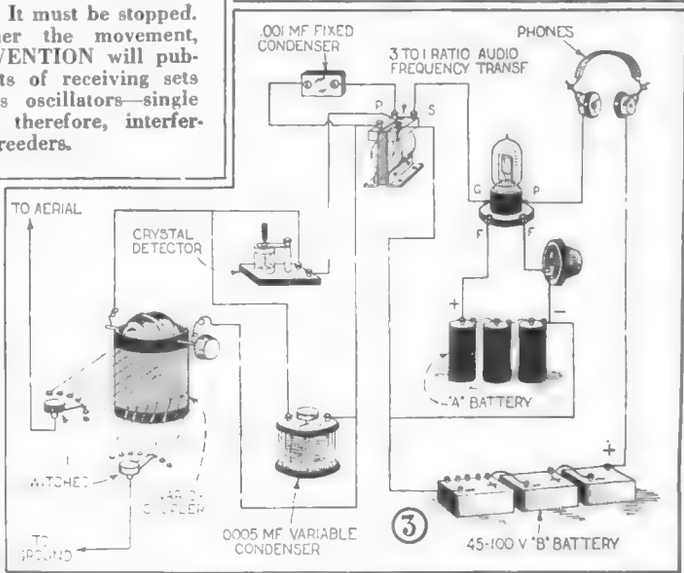
Directly below, in Fig. 2 is illustrated a form of reflex receiver employing only a single tube with a crystal detector. This set, when properly operated, will not oscillate and, therefore, will not cause radiation and its consequent interference. The potentiometer connected across the "A" battery is necessary in order to control the grid bias of the amplifying tube. If this is not included in the circuit, it will probably be found that the apparatus will not function properly. In order to further reduce any possibility of radiation, a vario-coupler is shown for use in tuning the antenna circuit. Because of the inductive transformation, any tendency to radiate will be stopped. All radio and audio frequency transformers will not work properly in this circuit and it is advisable to obtain those which have been tested and proven satisfactory when used for "reflexing." A hard tube must be used as it acts as an amplifier.

Stop Re-Radiation!

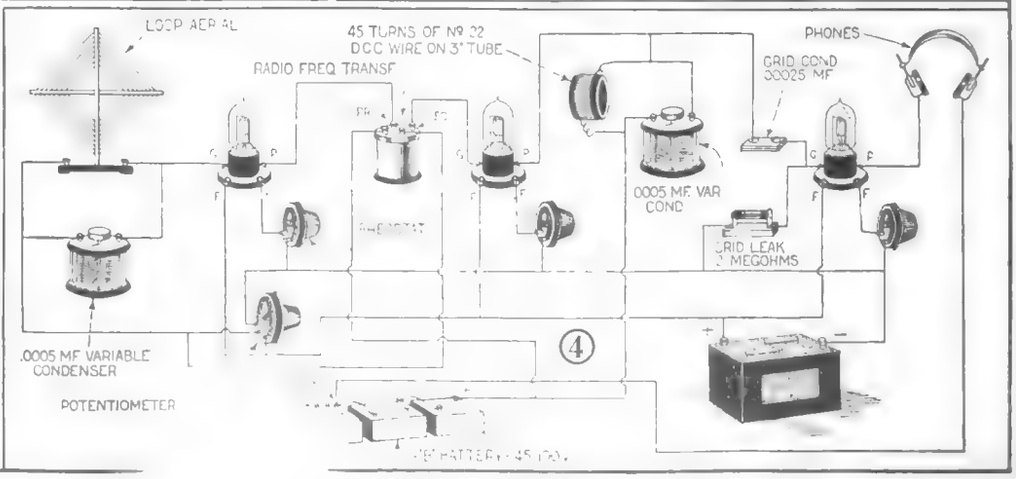
When operating a single circuit tuner, very often whistles and noises are heard in the receivers due to the fact that the circuit is oscillating. This is not only annoying to the operator, but at the same time the receiving set is acting as a miniature transmitter, sending out waves which cause severe interference with nearby receiving sets. Now that radio has come to be such a country-wide institution, it is necessary for something to be done about the interference caused by radiation. It must be stopped. In order to further the movement, SCIENCE AND INVENTION will publish no more circuits of receiving sets which are notorious oscillators—single circuit tuners—and, therefore, interference breeders.

Below in Fig. 3 is shown a circuit diagram of a radio receiving set employing a crystal detector for rectification and a single vacuum tube for amplification. No oscillation can take place in the secondary circuit of this receiver and it is absolutely non-radiating. The vacuum tube used should be of the amplifying type with a comparatively high voltage on the plate. To make the set more economical in operation, a W. D.-11 or W. D.-12 tube which requires only one dry cell for heating the filament, may be used. Any standard three-to-one or five-to-one ratio audio frequency transformer may be used between the crystal detector and the vacuum tube. This set, while not being capable of any great distance reception will, however, increase greatly the volume obtained from nearby stations. It will be appreciated especially in situations where many receiving sets are located in close proximity to each other.





At the right, in Fig. 4 is shown a circuit for the "DX hounds", especially those who want to make up a compact receiver, capable of operating on a loop antenna. If this circuit is provided with a vario-coupler, the rotor being connected in place of the loop antenna and the stator to an aerial and ground, a great amount of distance work may be expected. However, even in the form shown herewith, very good results will be found on "DX" work. A standard radio frequency amplifying transformer is used between the first and second tubes and the second stage of radio frequency amplification is coupled to the detector by the tuned impedance method. This gives very great selectivity and no trouble should be found in trying to tune in one station, even when another one is operating on very nearly the same wave-length. Even if an outdoor antenna is used, the selectivity will still be almost razor sharp and the signals will be reproduced with great clarity. The grid bias of the two radio frequency amplifying tubes is controlled by means of the potentiometer.



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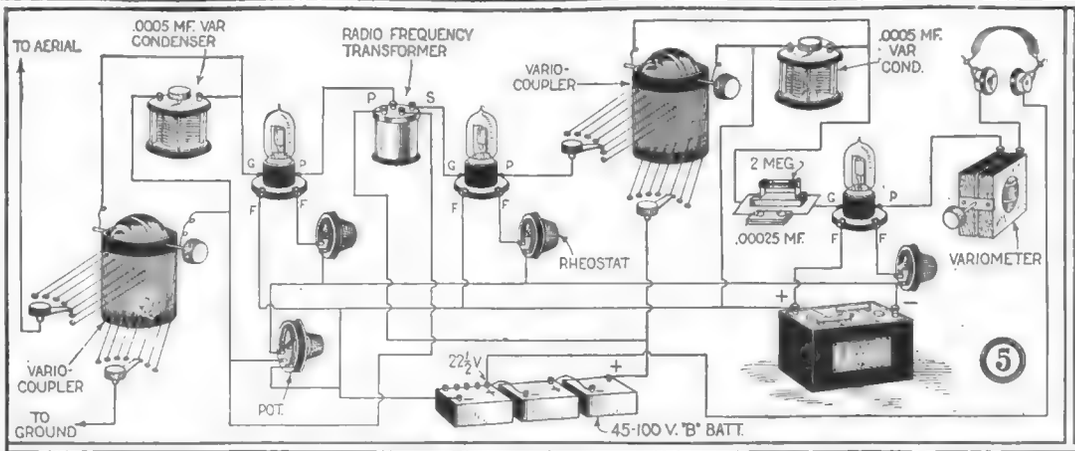
In Regenerative Tuners

Institute Radio Engineers



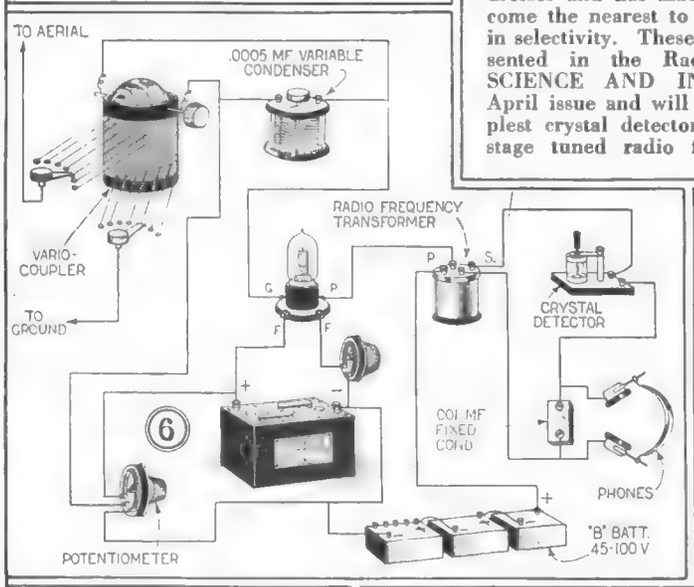
While the standard three circuit tuner consisting of either a vario-coupler and two variometers or a variocoupler, variable condenser and variometer is not a notorious radiator, still it sometimes happens that the set will go into oscillation and will cause interference with nearby receiving stations. To practically eliminate this trouble, it is only necessary to add radio frequency amplification before the tuner. This will at the same time increase the receiving range. In order to still further eliminate any chance of stray oscillations finding their way to the antenna circuit, a double circuit tuner is used for tuning the aerial. This consists of a vario-coupler with a variable condenser shunted across the rotor. Such a circuit employing two stages of radio frequency amplification and a three circuit tuner will be seen at the right in Fig. 5.

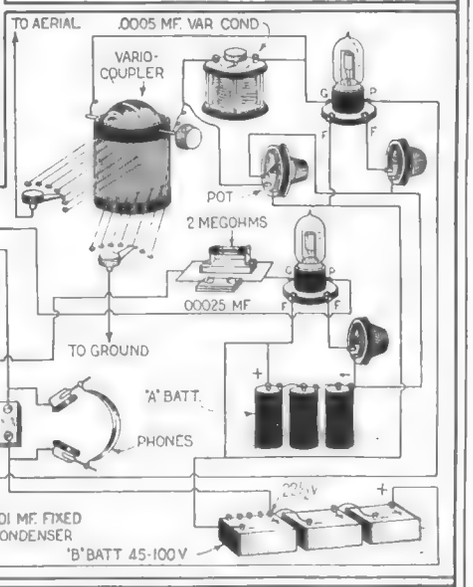
The circuit diagram below, Fig. 6, shows how to add one stage of radio frequency amplification to a standard crystal receiver which uses a vario-coupler for tuning. The addition of this amplification has a two-fold advantage. It increases selectivity and at the same time makes possible the reception of stations located at a greater distance than could be reached with a crystal detector alone. Very little possibility of radiation will be found when this circuit is used, since the vacuum tube is kept from oscillation by means of the potentiometer. Furthermore, the secondary or grid circuit is inductively coupled to the antenna which also reduces the chance of radiation. The crystal detector should be of a quite rugged type and the crystal itself should be capable of passing quite a large amount of current.

SELECTIVITY

Hand in hand with the prevention of radiation from receiving sets goes the problem of producing the greatest selectivity with the minimum amount of controls. John V. L. Hogan, an authority on radio subjects, has recently given several talks on the prevention of interference. The writer of the article on preventing radiation which is presented herewith has extracted the essential points from Mr. Hogan's various addresses and has made up circuits which come the nearest to being the last word in selectivity. These circuits will be presented in the Radio Department of SCIENCE AND INVENTION in the April issue and will range from the simplest crystal detector circuit to a multi-stage tuned radio frequency amplifier.

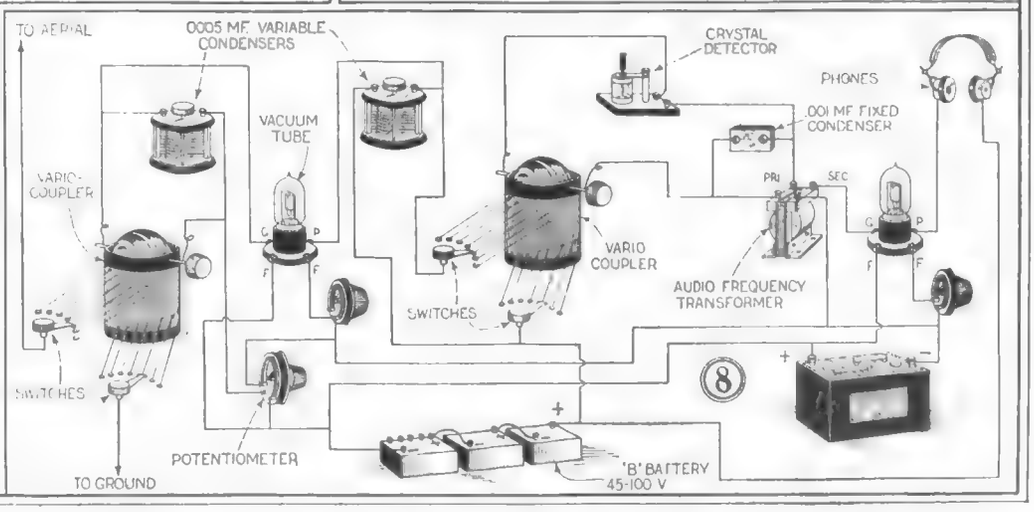
Radio frequency amplification may be added to a standard single circuit tuner in much the same manner as it is added to a three circuit tuner. The circuit diagram for this work is given below in Fig. 7. The addition of this single stage of radio frequency amplification as well as the use of a variocoupler or two circuit tuner in the antenna circuit reduces radiation considerably and practically prevents all interference with nearby receivers. All the information necessary for the construction of such a set is given in the circuit diagram below. Standard instruments may be used throughout as there is nothing "tricky" about the circuit. Very good selectivity may be expected from a set of this type as the radio frequency amplification is coupled to the detector by means of the stator of one of the vario-couplers. A small variable condenser is shunted across this coil





The crystal detector is well known for its clarity in reproduction of radio telephone conversation and music. Because of this fact, it will be found that the circuit diagram shown at the right will give excellent results in many ways. First, the reproduced signals will have a fine quality and very little distortion will be experienced. Because of the one stage of audio frequency amplification, the resulting volume will be built up to quite a great extent. The use of one stage of radio frequency amplification will enable the operator to tune in distant stations. Because of the fact that a vario-coupler is used between the radio frequency amplifier and the crystal detector, great selectivity may be expected.

In connection with the problem of reducing radiation, it will be noticed that all of the circuits shown herewith have a two circuit tuner in the antenna circuit. This fact in itself will aid materially in reducing radiation and this point should be remembered in changing any set.



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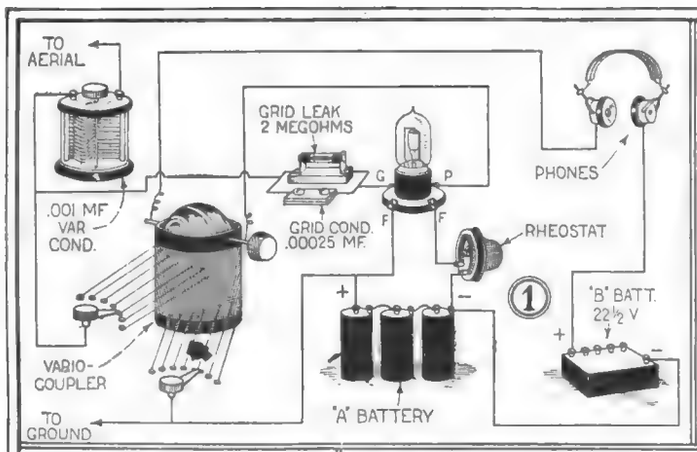
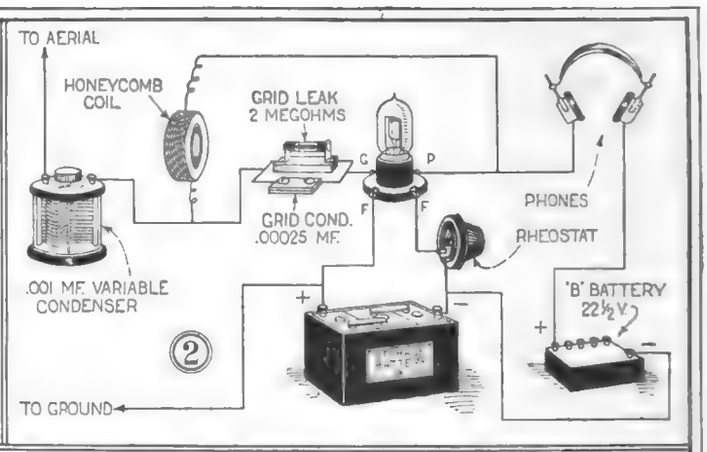
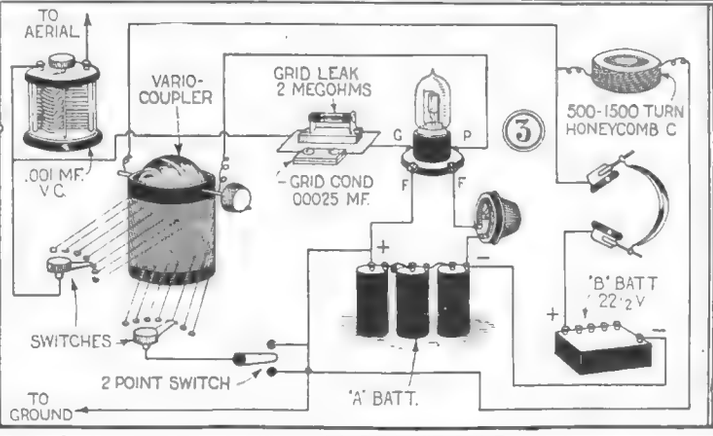
A Long Wave Receiver



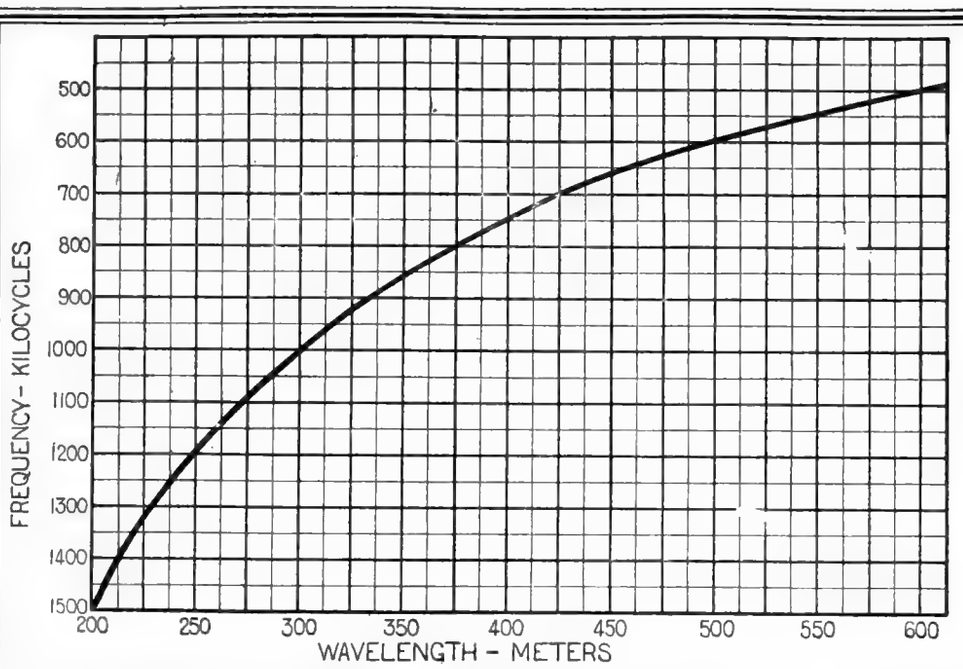


To those who know the radio telegraphic or International Morse code, there is a world of pleasure and information available on the higher wave-lengths. Such stations as WII, located in New Brunswick, N. J., NAA, at Arlington, Va., and some of the European stations such as FL, Eiffel Tower, Paris, France, and POZ, Nauen, Germany, send press and other items of general interest on wave-lengths ranging from 6,000 to 20,000 meters. These transmissions are on arc sets which have to be received with an oscillating receiver. Of course, much of the traffic is in code, but nevertheless, there is sufficient straight material to be of interest. In Fig. 1 we show a standard single circuit tuner which is a very good oscillator. This set is used by many amateurs even though its radiating qualities make it quite a notorious generator of interference.



In Fig. 2 is shown an adaptation of the De Forest Ultra-Audion circuit, which, with a large honeycomb coil, makes an excellent receiver for the long waves. It is advisable to have at hand honeycomb coils of the following sizes: 500, 750, 1,000, 1,250 and 1,500 turns. In the interest of economy, the first two sizes may be omitted as they are seldom used. Using a single tube circuit of this type, with the correct size of honeycomb coils, arc transmission may be received over distances ranging from 3,000 to 5,000 miles. Fig 3 shows a combination of the Ultra-Audion circuit shown in Fig. 2 and the single circuit tuner shown in Fig. 1. The only addition necessary to Fig. 1 is a honeycomb coil and a two point switch. With this last addition, either the straight single circuit tuner or the high wave-length receiver may be used. —Paul Oard.

What Are Kilocycles?



The Radio Conference at Washington recommended that the wave sent out from transmitting stations be expressed in terms of frequency instead of the usual measurement of the wave-length in meters. The chart on the left shows the frequency in kilocycles from 200 to 625 meters. As the wave-length in meters increases, the frequency in kilocycles decreases. In fact, the frequency varies inversely with the wave-length in meters between those in either of the charts given herewith the amateur can apply the following formula:

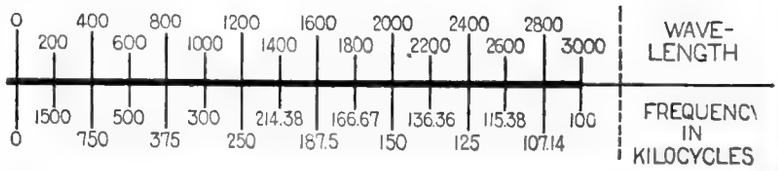
$$F = \frac{V}{\lambda}$$

In this formula F equals the frequency in cycles, λ the wave-length in meters and V, the velocity of radio waves which is approximately 300,000,000 meters per second. For determining the frequency of a 300 meter wave-length, the substitution is made as follows:

$$F = \frac{300{,}000{,}000}{300} = 1{,}000{,}000$$

This answer is in cycles and for kilocycles it must be divided by 1,000.

The chart at the right gives the frequency in kilocycles of any wave-length from zero to 3,000 meters in steps of 200 meters. When intervening wave-lengths are used, the [illegible] for finding the frequency in kilocycles will be [illegible] the caption above and at the right. In the [illegible]art, the perpendicular line indicating wave-length [illegible]ved to the curve. Then follow the horizontal [illegible] the left. Here will be found the frequency.



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Radio Oracle

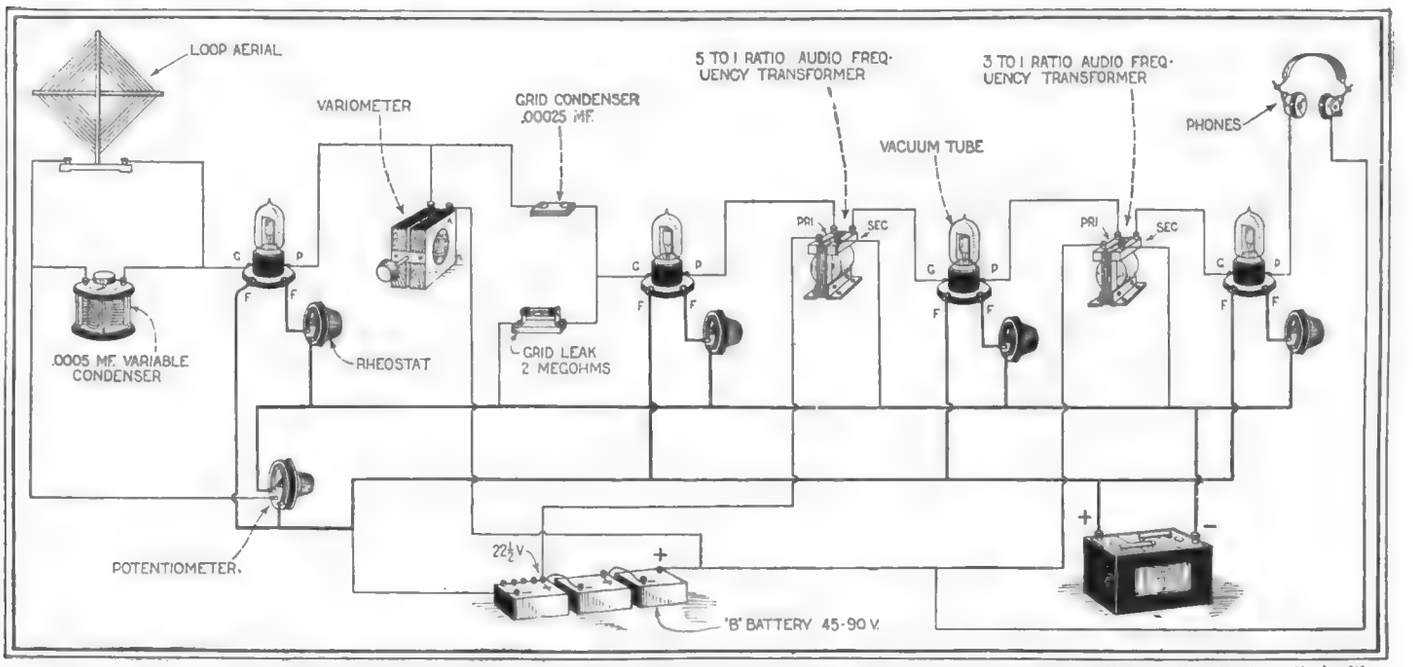
In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c. is made for all questions where a personal answer is desired.

RADIO AND AUDIO FREQUENCY AMPLIFICATION

(228) Austin Peterson, Sheffield, Ill., asks the Radio Oracle:

Q. 1. Can you give me a circuit diagram showing how to connect up one stage of radio frequency amplification, a detector and two stages of audio frequency amplification using a loop antenna and a variometer to tune the radio frequency amplifier?

A. 1. The diagram for this arrangement will be found in these columns.



Q. 228. A very simple and fairly efficient radio receiving circuit, consisting of one stage of radio frequency amplification, a vacuum tube detector, and two stages of audio frequency amplification is shown above. The controls are exceedingly simple, only one tuning control being used. A loop antenna is the collector agency. A variometer is used for coupling between the radio frequency amplifier and the detector. Used with a loop, this form of tuned impedance amplification gives quite sharp tuning, but if an outdoor antenna is to be used, an inductance coil and a variable condenser in parallel should be connected in the circuit in place of the variometer shown herewith.

JACKS IN REFLEX SET

(229) A. H. Patterson, Lynchburg, Va., asks:

Q. 1. Can I use filament control jacks in a three tube Reflex circuit?

A. 1. It is impossible to use filament control jacks with a three tube Reflex circuit for the simple reason that none of the filaments of the Reflex amplifiers can be out while the set is in operation. We would advise you to use a standard three-tube Reflex Circuit which will be supplied upon receipt of our usual charge or which can be found in various past issues of SCIENCE AND INVENTION.

TESTING A VACUUM TUBE

(230) Homer J. Jones, Canton, Ohio, asks:

Q. 1. How can I test a vacuum tube when I purchase it so as to be sure that it is in good condition?

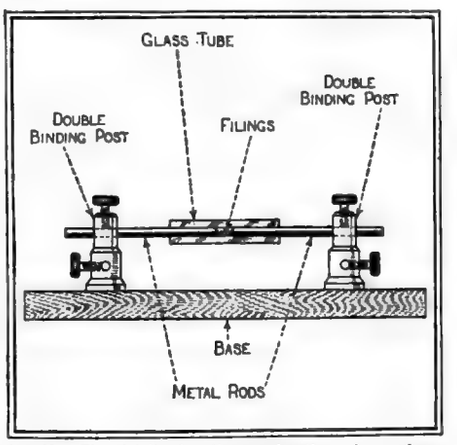
A. 1. The only way that you can test a vacuum tube is to see that the filament lights. If you desire a further test, it will be necessary to use it in a radio receiving set. If the tube will not pass plate current, it will not work in the set.

COHERER CONSTRUCTION

(231) J. L. Jones, Beatrice, Alabama, says that he desires to do some experimental work in connection with radio control. He asks:

Q. 1. Can you give me some information on the construction of a coherer?

A. 1. The construction and the action of the coherer are fully explained in any ordinary text book on radio, particularly the older ones. No exact dimensions are necessary for this instrument, a glass tube one quarter of an inch inside diameter sufficing for the supporting element. Two metallic plugs which will fit closely within this tube are used and between their ends, which are adjusted to about one quarter of an inch apart, is placed a quantity of nickel or nickel and silver filings. The construction is shown herewith. Any suitable mounting may be arranged.



Q. 231. The details for the construction of a coherer are given above. This type of detector is obsolete at the present date, but sometimes is used in connection with experimental radio control apparatus.

TUNED RADIO FREQUENCY AMPLIFICATION

(232) Irvin F. Marutz, Freelandville, Indiana, refers to an article entitled, "A Tuned Impedance Radio Frequency Receiver," which appeared in the July, 1923, issue of this magazine. He asks:

Q. 1. In the circuit diagram given, what is the capacity of condensers C3, C4, and C5?

A. 1. In the radio receiving set you mention, condenser C3 has a capacity of .001 mf., C4, .0005 mf., and C5, .00025 mf.

Q. 2. Could another stage of radio frequency amplification be added to this circuit using another coil and condenser?

A 2. Another stage of radio frequency amplification could be added to this circuit, but we would not advise its use as it would be difficult to control. You would do better to use the Neutrodyne principle. The circuit of a three tube Neutrodyne set will be given in the next issue of this magazine.

RADIO SET ON FARM LIGHTING PLANT

(233) J. J. Gloudemans, Brussels, Wis., says that he has a 32 volt direct current electric lighting plant and asks if he can use three cells of the plant to replace his "A" and Magnavox battery using at the same time one or more lamps for equalizing the other cells.

WANTED!!! RADIO ARTICLES

WE want descriptions of new radio ideas which you have worked out in practice. Take photographs of the important parts and make pencil or pen and ink sketches of the hook-ups or mechanical details, et cetera. We are particularly desirous of obtaining new hook-ups and descriptions of single tube sets, reflex and other types which have proven satisfactory. We want articles on the latest single tube receptors which require a minimum current from the filament battery.—Edi

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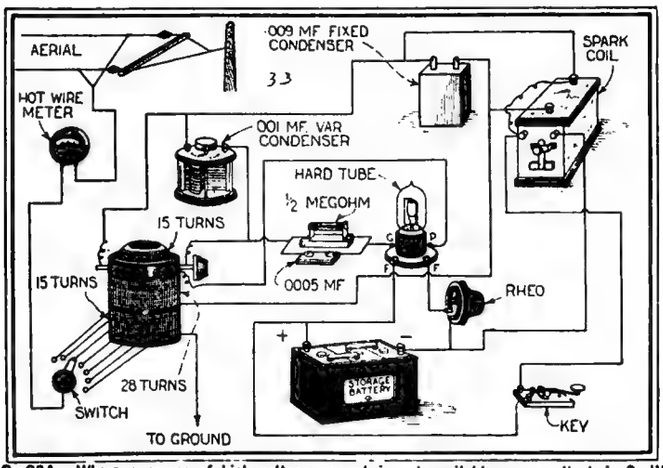
A. 1. You can run both the vacuum tubes in your radio set and your Magnavox from three cells of your lighting plant battery, and you would not need equalizing bulbs as you suggest. Just arrange the leads from your batteries to the set, so that they can be changed from one group to another occasionally. This will prevent one set of cells from deteriorating faster than another.



Q. 234. Where a source of high voltage current is not available, an excellent I. C. W. transmitter can be made using a spark coil for supplying the plate voltage to an amplifying or a five watt power tube. Do not connect this apparatus or attempt to use such a set until you have qualified for a license.

SPARK COIL C.W. TRANSMITTER

(234) Robert H. Trickey, Sask., Canada, requests:

Q. 1. Can you give me a circuit diagram showing how to connect up a U. V.-201 tube with a suitable source of high voltage such as a spark coil, so that the same may be used for C.W. transmission?

A. 1. A circuit diagram for this work will be found in these columns. The source of current may be a small coil capable of giving approximately a one-half inch spark. The condenser across the secondary should be of the glass plate type and must be of sufficient size to cut down the spark length so that a spark discharge will not take place within the vacuum tube.

TROUBLE SHOOTING

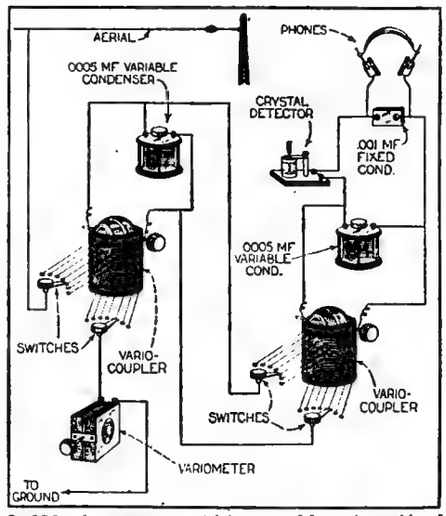
(235) Hugh Malcolm, Oneal, Ark., says that he has a radio set consisting of a variocoupler, a variable condenser, a variometer and the usual vacuum tube detector appliances. He says that he has been working this set for quite some time, but it suddenly went dead. He asks:

Q. 1. Can you help me in this matter?

A. 1. It sounds very much to us as though a connection has broken somewhere in the set, which, of course, renders it inoperative. We would advise you to investigate each instrument thoroughly and test all the circuits for continuity. It may be that either the grid or plate connections to the elements of your vacuum tube have broken and, therefore, the circuit is incomplete within the tube itself. The best way to test for this trouble is to obtain another bulb and place it in the socket. If signals come in, you then know that your bulb is defective. We would advise you to clean all your movable contacts and as stated above, test all circuits. If you are unable to locate your trouble, do not hesitate to write to us, giving complete information on the results obtained.

SELECTIVE CRYSTAL RECEIVER

(236) Carl S. Paulson, Brooklyn, N. Y., refers to our Interference Preventer Contest and asks us to show how to connect a crystal detector with the first prize winning circuit.

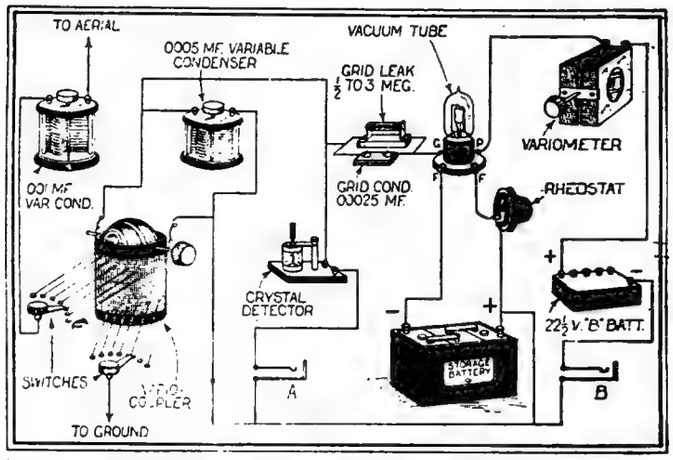


Q. 236. In congested districts, a receiving set capable of very fine tuning is desirable. Such a tuner used in connection with a crystal detector is shown herewith.

A. 1. In these columns will be found a diagram of the necessary connections for using the selective tuner with a crystal detector. While this set will be extremely selective, still its control will be very complicated and the signals will not be very loud because of the losses found in transformation.

COMBINATION CRYSTAL AND AUDION

(237) Jack Maloney, Liberty, N. Y., says:



Q. 237. Where a radio receiving set is located near several broadcast stations, a crystal detector can very readily be used for local reception, while a vacuum tube is desirable for DX work. A combination circuit which makes this possible is shown above. The telephone plug is to be placed as described in the text.

Q. 1. Please give a circuit diagram showing a variocoupler in connection with a crystal detector and an audion detector, so arranged by means of two jacks that either the crystal or vacuum tube may be used as desired.

A. 1. You will find in these columns a circuit diagram such as requested by you. When the plug is in jack A the filament of the vacuum tube should be extinguished and the crystal detector may be used. When the plug is in jack B, the filament of the tube is to be lighted and the set operated as a standard three circuit regenerative tuner.

A "MIXED" CIRCUIT

(238) Benedict Massell, Allerton, Mass., submits a circuit diagram of a set consisting of two stages of radio frequency amplification, a detector and two stages of audio frequency amplification using the Reflex principle so as to obtain the above mentioned results with three tubes. In the detector circuit he proposes to use the principle of super-regeneration. He asks:

Q. 1. Do you think that this circuit is of any value?

A. 1. It is absolutely impossible for us to tell you just how your set will function without making the connections and trying it out. Frankly, we do not believe it to be of any value. Super-regeneration is so critical in control that, used in connection with the reflex principle, we believe that you would get a choice selection of howls, groans, squeaks and squeals. Either of the circuits which you have attempted to combine, on paper, are hard to control. Combined they would probably be impossible to control.

200 ILLUSTRATIONS—100 ARTICLES

is the average of every issue of Radio News. We doubt if there is a radio magazine in print that can show the diversity of articles and illustrations that is found in this magazine.

But above all, it is the quality of the material that is of prime importance to the man interested in radio. Radio News appeals to all factions: the Scientist, the Amateur, the Experimenter, the Broadcast Listener, and the Manufacturer. Each will find articles written especially for him. Every issue of Radio News is a radio education by itself. Sold on 35,000 newsstands in the United States and in every international book store in every civilized country the world over.

A LIST OF INTERESTING ARTICLES APPEARING IN THE MARCH ISSUE OF RADIO NEWS.

Recent Novelties in Thermionic Tubes for [illegible]dio Work.
By J. A. Fleming, D.Sc.
[illegible]stal Set Loud Speaker.
[illegible]evelopment of Wired Radio in Germany.
y Dr. Karl Rottgardt.

Tuning and What It Means.
By John V. L. Hogan.
Another Historic Event In Amateur Radio.
By Laurence S. Lees.
Rebroadcasting; a New Era in Radio.

The Operation of Close Coupled Transformers.
By W. P. Powers.
Modern Radio Apparatus—Condensers.
By Jesse Marsten.
Building a Neutrodyne and Making It "Neut".
By Lester D. Cushman.

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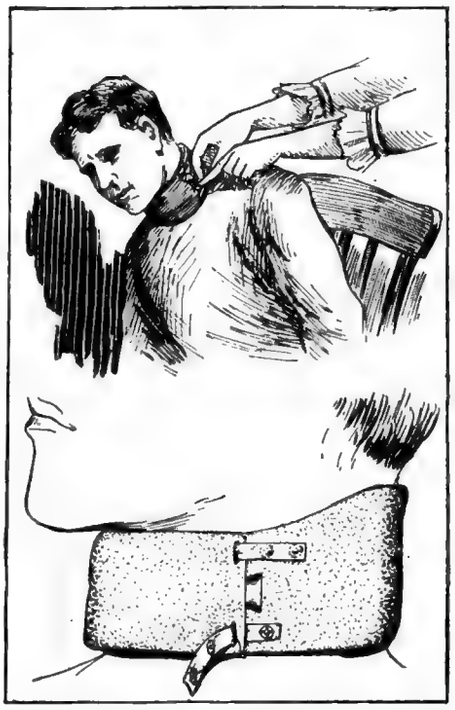
LATEST PATENTS

Thermotherapeutic Applicator

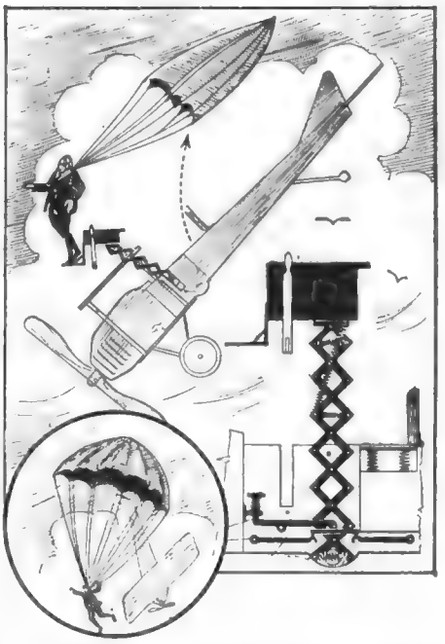


No. 1,473,506 issued to Sylvia Nessler. It seems strange that no one heretofore has thought of a hot water bottle designed for application to the neck and throat of the user in the treatment of various ailments. Here a container of soft rubber and of elongated design is covered by a fabric envelope. The ends of the envelope have straps attached to them for fastening the water-proof container in place. A filling nozzle will be found at one end positioned between the straps, through which the bag may be filled with either hot or cold water. Although the device may be filled when the rubber envelope is held within its surrounding felt envelope, it is advisable to remove the rubber bag.

Window Cleaner and Polisher

No. 1,473,395 issued to August M. Becker. In order to enable the outer surfaces of the windows of a building to be cleaned from within the building, a U-shaped frame was designed by the inventor. This frame has a handle connected to one of the leg portions and a window scrubbing and polishing device on the other, opposite the handle member, and by pulling upon the handle pressure can be applied to the windowpane, while by moving the device up and down or to either side, the entire surface of the window can be cleaned. The block holding the polisher and scrubber is then given a half turn and the rubber polisher is used for giving the window a finished appearance.

Airplane Safety Device

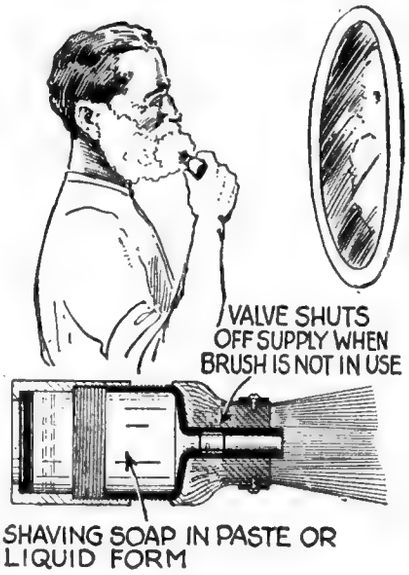


No. 1,475,322 issued to Emile Scheemacker and Georges Raimond. In order to enable an aviator who is controlling an airplane, to leap freely from the machine in event of an accident, a device has been designed which operates as follows: Under normal conditions the seat is held down in the fuselage by hooks and latches. In case of an accident, the aviator presses upon a treadle which releases the latches. The seat being thus released, the springs will cause the elongation of the lazy tongs and eject the seat from the fuselage, and at the same time another spring will swing the seat so that as the airplane plunges downward, the seat will be in approximately a horizontal position and the aviator will be standing upon the foot piece. The parachute to which the aviator is attached is carried in a pocket beneath the seat. It is obvious that as the seat rises the parachute will be released, thus enabling the aviator to safely reach the ground. What would happen in case the machine does not make a nose dive is something the inventor does not explain.

Disappearing Vehicle Step

No. 1,467,976 issued to Joseph R. Gannon. An automobile step of the nature here shown will disappear when the swinging door is closed. This step is made in segmental form and is approximately one quarter of a circular disk, the center of which disk is located underneath the door hinges. It disappears into a slot provided in the chassis body underneath the car floor. The under side of the step is provided with teeth-like projections, and at the foot of the door jamb a bracket may be found which will set itself between the teeth-like projections. When a person is getting into or out of the car, the placing of the person's weight upon the step firmly interlocks the step and the door.

Shaving Brush



No. 1,470,825 issued to Lewis Fritz. In this shaving brush a reservoir is found within the handle of the brush part, and from the handle a tube communicates with the bristles of the brush. A shaving soap compound in either a paste or a liquid form, is placed in the handle and due to the screw threads thereon, it is possible to cause this container of the handle to be made smaller by screwing the two parts one on the other, together, thus forcing the paste out into the brush. The main improvement of this brush over others is the fact that it will take both paste and liquid soaps.

Cream Extractor

No. 1,471,528 issued to Leslie C. Rawcliffe. The device comprises a bent tube as illustrated, a cap of tight fitting design, and an atomizer bulb. When the device is put into a milk bottle, it is impossible to see the bottom of the tube in the bottle, but an adjustable finger on the outside indicates the depth to which this tube sinks. The cream is extracted by compressing the bulb and forcing air through the pipe, which in turn forces the cream out. The cream coming through the tube then starts a siphon in action and continues to flow until the siphon breaks, which is as soon as the air reaches the level of the opening of the short arm of the siphon.

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Scientific Humor

BRINGING HOME THE S. O. SAGE

The wife told her absent-minded husband to bring home a few things from the grocery on his way home and admonished him not to forget them so he walked down the street repeating in a monotonous undertone S.O.S.—S.O.S. A friend, who happened to hear him asked him if he had gone "bugs" on radio. "Radio be damned," he exclaimed, "my wife told me to get *S*oap, *O*ranges and *S*ausage and I am trying to memorize them."—*James Thomas.*

STUNG!!

FATHER (*not versed in science*) to son (*"listening in"*): "What's this thing?"

SON: "Oh, that is the *'B'* battery."

FATHER: "Is that where you get your *honey-comb* coils?"—*K. Russell Gray.*

OUT-SPOKEN

CRABSHAW: "So your wife wouldn't have a radio in the house? Old-fashioned?"

HENPECK: "No, I think she was jealous of the loud speaker."—*Jas. J. O'Connell.*

CURED OF IN-FAT-UATION

In answer to an advertisement of a new patent on "How to Get Rid of Fat," a very fleshy lady sent in one dollar for the required information.

The answer she received was as follows: "To get rid of fat throw it in the garbage can."—*S. D. Snavely.*

COPPER HAS LEAST RESISTANCE

"Hey, Spiggs, what is Walt in tow for?"

"Nothin'. Just a secondary offense."

"What did he do?"

"Nothin'. Just followed the line of least resistance."

"Well—where does the secondary offense come in?"

"Just now offered resistance to the cop."—*J. L. Vanderheyden.*

CABINET SIZE

"What makes your sister so stout now; she used to be very thin?"

"She's working for a photographer."

"Why, how does that make a difference?"

"Well, she's in the developing room most of the time."—*John H. Schalek.*

QUITE STAR-TLING

TOM: "When a movie star takes on flesh she is no longer a star."

JOHN: "Why not?"

TOM: "Because she is a little meatier" (meteor).—*George Carr.*

NOPE, INSANITY

"What have you against this fellow?" asked the police sergeant.

"He's charged with bigotry," replied the cop.

"Bigotry?" exclaimed the sergeant. "Why they ain't no such crime as that."

"Sure there is," replied the cop; "he has three wives."

"Go on you chump," jeered the sergeant, "that ain't bigotry; that's trigonometry."—*Chas. R. Whitehouse.*

First Prize $3.00

FOILED!

JOHN (*a prominent radio fan*): "Mary, can you tell me what has become of that package of tin foil I bought the other day?"

MARY (*his wife*): "Yes, Mrs. Smith has been over here and asked me what it was good for. I told her that you said it would reduce body capacity, so she insisted on taking the entire lot and giving it a fair trial. The poor woman has tried every flesh reducing remedy except your tin foil."—*Irby Park.*

SOME JACK ASS

CLERK IN RADIO STORE: "We have a very fine plug here that would complete your set."

CUSTOMER: "Sorry, but I haven't got the 'Jack.'"—*John Scofield.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

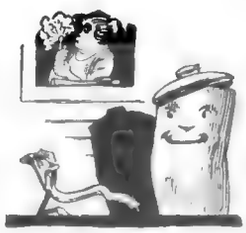
IN THE LAST QUARTER

VISITOR: "Who was that queer-acting fellow who was looking through the telescope?"

GUIDE: "Oh, that was our old astronomer Prof. Starduster. They say that he is a little 'off' because he is perpetually observing the moon."

VISITOR: "Oh I see. A sort of a *lunartic!*"—*Emil Guidici.*

"CHERCHEZ LA FEMME"



"You were thrown out?" remarked the ash barrel to the nail. "That's what you get for being crooked."

"The crookedness is not my fault," said the nail. "I was driven to it by a woman."—*John H. Schalek.*

AH—A SHORT-CIRCUIT!

"You may have the correct circuit," commented Henry Homebody, as he tried in vain to fasten the corset stays on his wife's ample form, "but I don't think much of your hook-up."—*H. S. Tillotson.*

HE REAPS WHAT HE SOWS

EXTRAORDINARY (*Teacher to Physics Class*): "What is a liter?"

BRIGHT STUDENT: "Why—er—a litter is the number of pigs an old sow has at one time."—*Ira J. Bailes,* Reporter No. 5110.

½ OF 1%

TEACHER: "Who was Eli Whitney?

BUSTER: "The gink who invented cotton gin but couldn't drink it."—*G. F. Morgan.*

APPLE SAUCE!

Isaac Newton shortly after being struck on the head by an apple, remarked, "I am struck by the gravity of the situation."—*Earl Wilkinson.*

LET'S ALL TRY IT

CRABSHAW: "So the wireless fad has spread out your way?"

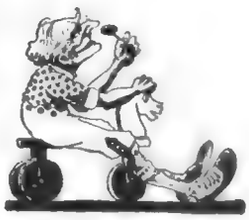
SUBURBS: "Why, we think no more of borrowing a radio set from a neighbor than of asking for his lawn-mower."—*Jas. J. O'Connell.*

WHO IS JO KING?

Why is the gas so line?
When did the ground swell?
Why does the wood dye?
Why was the weather vane?
Why did the rubber tire?
What does the wind shield?
Why did the foot brake?
When did the bell hop?

—*C. E. Simpson and Lloyd Hendricks.*

THEY MONKEYED WITH HIM



MONK: "How did Bill come out with his monkey gland treatment?"

KEY: "Well, his nephew got a letter from him a month ago in which Bill said he felt ten years younger. Then he got another one and Bill said he felt like a boy."

MONK: "Aw right, go on."

KEY: "Then he got a telegram which stated that Bill had died an hour ago of infantile paralysis."—*J. Gaskins.*

QUITE INTERUSTING

TEACHER: "Where else is iron found, James?"

JAMES: "Well, I know there is some iron in our bodies."

WILLIE (*out loud*): "Now I know what those things are on Johnny's face. He must have forgotten to wipe his face dry and the iron rusted."—*S. Fishman.*

RADIO BUGS, NOTE!

MRS. FLYNN: "I don't know what to make for supper tonight. It's such a task nowadays to think of something different to prepare each night."

MRS. JONES: "Why not try some radio ham we have read so much about these days?"—*Sidney Lang.*

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THE ORACLE

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

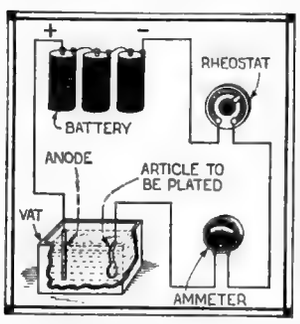
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to the department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

CIRCUIT FOR COPPER PLATING

(1627) Leonard Doctors, Glen Head, L. I., asks:

Q. 1. Can you give me a circuit for connecting up all the apparatus necessary in copper plating?

A. 1. The diagram herewith shows all the necessary connections. In copper plating you should calculate the number of square inches of material to be plated and allow one-tenth of an ampere to flow through the circuit for every square inch of surface to be plated. For this reason the ammeter must be included in the circuit. Rather use a little less current than too much for if the object is plated too quickly the deposit will not be of a good quality and will not stay on the object.



When articles are to be copper plated, a suitable vat for containing the articles and a copper anode must first be provided. This is then filled with the plating solution and the copper anode and articles to be plated suspended therein.

MAGNETO QUERY

(1628) H. P. Blake, Richmond, Va., asks:

Q. 1. Is there any manner in which I can increase the spark developed by a magneto? I have one on hand which sparks across the safety gaps when the shaft is turned by the hand?

A. 1. In regard to your magneto query, we would say that your magneto must be delivering its best spark, if when turned by hand the spark jumps across the safety gaps easily. You cannot improve the spark further under such conditions.

Q. 2. How many volts would be required to pass current through the bodies of two persons, said current to be delivered by the above mentioned magneto?

A. 2. The voltage required to pass a current through the bodies of two persons, under the conditions you mention would depend upn the resistance of each individual. The resistance of the body varies considerably and the amount of voltage required would also depend upon the contact maintained between the two bodies and the surface at which contact was made.

WATER-PROOFING CANVAS

(1629) Raymond L. Lucchesi, Merced, Cal., requests:

Q. 1. What is a good formula for a preparation which may be used to water-proof canvas?

A. 1. For water-proofing canvas we would advise you to use the following solution. For every gallon of turpentine necessary to treat the amount of canvas you have on hand, shave up a half pound of pure paraffin wax. When this is sliced up very fine, add it to the turpentine, which latter should be warm, and stir it thoroughly till the wax dissolves. The canvas can then be soaked in this mixture. When it is thoroughly impregnated with the same, hang it up smoothly to dry.

Interesting Articles in March "Practical Electrics"

THE STACCATONE

A brand new musical instrument giving weird and staccato like sounds. Anyone who has a loud-speaker, a vacuum tube and a few honey-comb coils can make this remarkable instrument, recently developed by Mr. H. Gernsback. Read all about it in the March issue of PRACTICAL ELECTRICS.

Photo-Electric Telephony
By Dr. A. Gradenwitz, Berlin, Germany
Solar Radiation Measurement
By H. H. Kimball and H. E. Hobbs, U. S. Weather Bureau
Television by Belin System
By Lucien Fournier, Paris, France
Electric Clock Runs 1000 Years
Submarine Pilot Cable
By Dr. A. Neuburger, Berlin, Germany.
World's Largest Electric Generator
Sam Graves' Gravity Nullifier
Story by George F. Stratton
Simplified D'Arsonval Galvanometer
Automobile Ignition Coils
Voltmeter Multipliers

MAGNETIC REPULSION

(1630) H. W. Loury, Tampa, Fla., says that he has heard of a metal which will be strongly repelled by an electro magnet. He asks:

Q. 1. Can you give me some definite information on this subject?

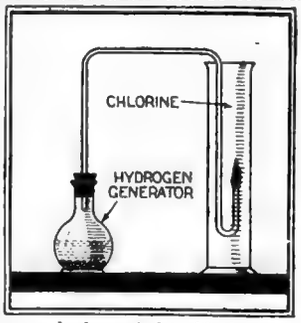
A. 1. A ring of aluminum placed over the end of an electro magnet actuated by A. C. will be forcibly repelled from the magnet. A very powerful magnet must be used, however, to obtain this effect. Metallic bismuth is slightly repelled from an ordinary horseshoe magnet, but not to any great extent. A very delicate suspension of the bismuth must be made in order to observe the effect.

PRODUCTION OF HYDROCHLORIC ACID

(1631) D. Y. Salinzer, Toronto, Ont., Canada, asks:

Q. 1. How can hydrochloric acid be obtained by combustion of hydrogen gas?

A. 1. If hydrogen gas is allowed to burn in air, it is well known that water will be formed.



Hydrochloric acid may be prepared in an experimental way by collecting a quantity of chlorine, starting a hydrogen generator and leading a pipe from the latter to the vessel containing the chlorine. The hydrogen is lighted at the end of the pipe.

If, however, the gas is burned in chlorine gas, hydrochloric acid will be formed.

REDUCTION OF SPARKING

(1632) Maurice Plata, Chicago, Ill., asks:

Q. 1. How can I reduce the sparking formed at the contacts on the vibrator of an ordinary buzzer?

A. 1 If you will shunt a fixed condenser with a capacity of about one mfd. across the contacts which are used for breaking the circuit of your buzzer you will find that the sparking will be greatly reduced.

COLORED GOLD

(1633) Simon Blanco, Miycauayan, Bulacan, P. I., asks:

Q. 1. How are the various degrees of colored gold used in jewelry obtained?

A. 1. The process of making various colored alloys of gold merely consists in melting together various quantities of different metals. To make green gold, melt together 750 parts of pure gold, 150 parts of pure silver, and 100 parts of pure copper.

OUR $12,000 PRIZE CONTEST

T will be noted from recent issues and the present one that our prize contest has been a whale of a success. Over $1,000 has been paid out this month for worth while contributions to SCIENCE AND INVENTION, either in pictures, suggestions, ideas or articles. We now have on our staff, close to 8,000 correspondent reporters who are scouting the world for new material that can be written up for SCIENCE AND INVENTION. And the formula is simple—just keep your eyes open. Even if you were totally deaf or blind, you could still win a prize by simply using your head and sending us ideas of a scientific nature, or of a nature directly or indirectly attached to new inventions.

ARTICLES FOR APRIL SCIENCE AND INVENTION

How the Shenandoah Will be Moored on the Polar Route
By Graser Schornstheimer, Naval Expert

Largest Bridge in the World to Span the Golden Gate
Illustrated by Louis Biederman

Measuring the Heat in the Stars' Spectrum
By Dr. C. G. Abbot

If You Traveled on a Light Wave—A Popular Exposition of Einstein.
By Ernest Brennecke

Listening to the Voices of the Insect World
By W. W. Rodgers

A Theatre Cathedral—World's Most Gorgeous Theatrical Production.

Selective Non-Radiating Receiving Sets—A Complete Review
By A. P. Peck

Railroads of To-morrow
Illustrated by C. McKnight Smith

Ancient Clocks—How They Worked
By Charles Beecher Bunnell

Match Box Tricks—Third Article
By Walter B. Gibson

How to Take Care of Your Watch—A practical illustrated article
By Samuel Bernard, Watch and Clock Expert

Radio Department will include a number of valuable articles you should not miss.

FREE INFORMATION

IF you want additional information concerning any of the subjects illustrated and described in this number of SCIENCE AND INVENTION we shall be glad to give you other data we have at our command. To make this work as easy as possible for our editors, please be brief. Write only on one side of the paper and state exactly in a few words just what it is you desire further information on. We have the original manuscripts and drawings of many of these articles in our files and can furnish much additional data in most cases. Please do not fail to send stamped and self-addressed envelope.

Address all inquiries of this nature to INFORMATION EDITOR c/o Science and Invention, 53 Park Place, New York City.

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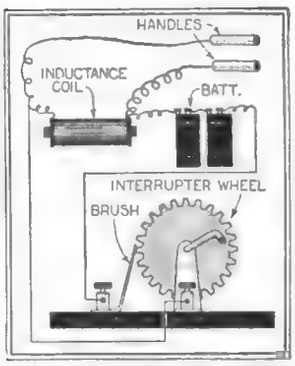
SHOCK FROM INDUCTION

(1634) Alexander Gill, Milwaukee, Wis., wants to know:

Q. 1. Can you tell me of a simple method for making a shocking machine without the use of an induction coil?

A. 1. Probably the simplest method of obtaining the results you desire is to form an apparatus similar to that illustrated herewith. A "kick" coil or inductance is used and may consist of two layers of No. 24 cotton covered wire wound on an iron core ¼ of an inch in diameter by 3 inches long. A gear wheel from a small constructional set may be used as an interrupter by mounting it as shown. If a person grips the two handles, and the wheel is turned quite rapidly, quite a sharp shock will be felt.



A small experimental shocking coil can readily be made by means of an inductance coil such as described in the text, connected with two or three dry cells and an interrupter wheel as shown at the left. The inductance coil is of the auto-transformer type.

WIRE SEALED IN GLASS

(1635) Milvin Bergland, Joice, Iowa, asks:

Q. 1. What are the wires composed of which are sealed into the glass in the making of electric light bulbs?

A. 1. The leads that pass through the glass in an electric light bulb were originally made of platinum, but of late a combination of metals known as Dumet has been evolved, which has practically the same coefficient of expansion as glass, and therefore lends itself admirably to this purpose.

Q. 2. What metal is used for the contact points on spark coils?

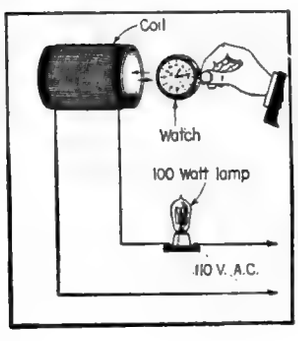
A. 2. Various hard metals are used for the contact points on spark coils, all of them being alloys. The alloy of platinum and iridium is most frequently used.

DEMAGNETIZING A WATCH

(1636) G. B. Pew, Blaine, W. Va., says that he has a watch which has become quite strongly magnetized and does not run properly. He asks:

Q. 1. Can you give me directions for demagnetizing this watch?

A. 1. We would advise you to construct a coil for demagnetizing your watch as follows. On a tube 3½ inches in diameter, wind 150 turns of No. 20 D.C.C. wire. Connect this directly across 110 volt A.C. supply with a 100 watt lamp in series with the same. Place the watch in the coil and turn on the current and withdraw slowly. Two applications may be necessary in order to thoroughly demagnetize the watch.



At the left is shown a circuit for a demagnetizing coil and the method of applying it to a magnetized watch. This method is practical and will render serviceable a watch which has stopped running because of being magnetized.

INDIVIDUAL BRAKES FOR AUTOMOBILE WHEELS

(1637) H. Pierce, Springfield, Mass., asks:

Q. 1. Do you think it would be feasible to have a separate brake for each of the rear wheels on an automobile? I believe that this would be advantageous as the two pedals could be worked together so as to assist in straightening out the car when it skids.

A. 1. The control of the average automobile is complicated enough at the present time without adding independent brakes for the wheels. It would only tend to confuse the driver to a greater extent and if anything, would induce skidding rather than prevent it. This is because of the fact that the brakes would not be applied evenly to the rear wheels and one wheel would tend to travel faster than the other, thereby of course, inducing skidding.

A DISCUSSION ON ASTRONOMY

(1638) Ralph E. Busse, Canton, Miss., puts forth the following opinion on astronomy:

"No light or heat, as such, comes to the earth from the sun. Nor do we get any, as such, from the moon or any of the stars. What we do get is electricity or electrons which, on striking the atmosphere of the earth, separate into heat and light. In other words, if a person could get outside of the atmosphere he could not see anything; earth, moon, sun and stars would disappear. There is no such a thing as ether. Vacuum rules supreme in the interstellar space. This I believe coincides with Einstein's theory and may, if used as a basis for further investigations, help to clear up some of the things which we are unable to explain with the ether theory, such as 'Northern Lights,' thunderstorms, etc. Also, I believe that the moon shines by reflected electricity."

Mrs. Isabel M. Lewis, M. A., of the U. S. Naval Observatory, replies as follows:

"In reply to Mr. Busse's suggestions, I would like to call attention to a fact that is known observationally, that as the atmosphere gets more rare, on high mountains, for example, the stars shine more brightly and more of the fainter stars become visible. This is against Mr. Busse's theory that the heavenly bodies would disappear if a person could get outside of the atmosphere. It is well known that the rarer the atmosphere the more brilliant the heavenly bodies appear. Of course, electrons from the sun do strike the upper atmosphere and cause the 'Northern Lights.' The spectrum of these lights is very different from the spectrum of the light that comes to us from the moon, which is the same as the solar spectrum. If the moon shone by reflected electricity instead of reflected sunlight its spectrum would resemble rather that of the 'Northern Lights,' which is that of elements electrically excited.

"It is also not true that the ether theory leaves unexplained the phenomenon of the 'Northern Lights' and thunderstorms. Their cause is well known.

"As I understand it, Einstein's theory of relativity is not founded upon any assumptions whatever as to the existence or non-existence of the ether. It does state that it is impossible to determine the motion of the earth with respect to the ether or through space from observation made on the earth alone.

"After all, light involves action on the retina of the eye. The blind man sees no stars, atmosphere or no atmosphere."

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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To ..... Newsdealer

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BLUEPRINT PAPER

(1639) F. L. Richards, Minneapolis, Minn., wants to know:

Q. 1. What is a good formula for making blueprint paper?

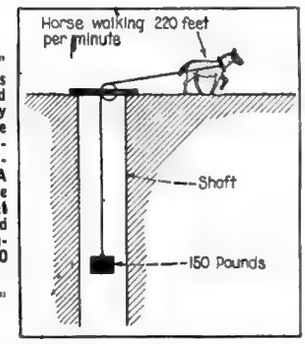
A. 1 Mix together 55 grains of ferric-ammonium citrate with ½ ounce of water. Make another solution of potassium ferricyanide, 20 grains, and, water, ½ ounce. Mix together equal parts by volume of these two solutions and keep in a yellow glass bottle in a dark place. Just before using, the resulting solution should be filtered. It is then applied to the paper, which is stretched out and pinned down, with a wad of cotton, brushing out until the paper is evenly moistened. The paper should then be dried in the dark and used as soon as possible after being thoroughly dried.

HORSE-POWER

(1640) J. W. Eisenstadt, McKeesport, Penna., asks:

Q. 1. How was the horse-power unit originally determined?

A. 1. When James Watt was conducting his early investigations in steam engines, he decided that a standard measurement of work was necessary. He decided that the horse would be a good standard and after some experimental work, he arranged apparatus as shown herewith, wherein a weight of 150 pounds was suspended in quite a deep shaft. He attached the other end of the rope to a horse and found that the latter could walk at a rate of about 220 feet per minute while raising the weight. He therefore, multiplied 220 by 150 giving 33,000 foot-pounds per minute and adopted this unit for measurement, naming it the "horse-power."



At the right is shown the method used in originally determining the foot-pounds of energy to the horse-power unit. A horse of average strength walking at an average speed was used in connection with a 150 pound weight.

SAWING A WOMAN IN HALF

(1641) Morris Levine, Brooklyn, N. Y., asks:

Q. 1. Can you explain to me how the trick which I have seen performed on the stage and which consists of presumably sawing a woman in half is performed?

A. 1. The trick of "Sawing a Woman in Half" was fully explained in the December, 1921, issue of SCIENCE AND INVENTION. This may be obtained from our Subscription Department.

Q. 2. What is a galvanometer used for?

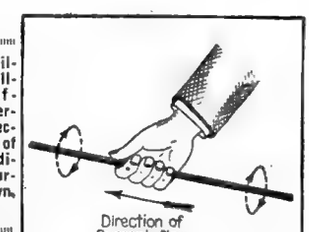
A. 2. A galvanometer is used to indicate the presence of a minute current of electricity and is used in various measuring and indicating apparatus.

RULE OF THUMB

(1642) Richard Kruger, Glen Head, L. I., wants to know:

Q. 1. When the direction of the flow of current in a wire is known, how can the direction of the lines of force be determined?

A. 1. The illustration herewith shows the so-called right hand rule of thumb for the determination of the direction of the lines of force. The right hand is placed on the wire with the thumb pointing in the direction of the current and the fingers grasping the wire. The direction in which the fingers point show the direction of the lines of force.



At the right is illustrated the well-known rule-of-thumb for determining the direction of the lines of force when the direction of the current flow is known, or vice versa.

MATT SURFACE PRINTS

(1643) Louis J. Fenstein, Arlington, N. J., asks:

Q. 1. How can ordinary printing paper with a fairly smooth surface be given a matt surface?

A. 1. After the prints have been made and thoroughly fixed and washed, they can be given a matt surface by squeezing to a ground glass, and allowing to dry in this position. These prints must then be mounted dry, using a mounting tissue or a rubber cement. Never mount such prints wet or with ordinary paste.

ARTIFICIAL SMOKE

(1644) Wm. P. Predmore, Broken Bow, Neb., says that he desires to produce small quantities of smoke for amateur stage productions and asks:

Q. 1. How can this be done in a safe manner?

A. 1. The best and easiest way to produce artificial smoke for small stage productions is to allow the fumes of ammonia to come in contact with the fumes of hydrochloric acid.

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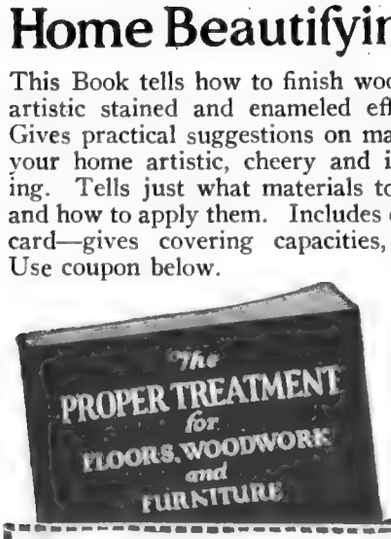

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The Month's Books

A digest of the general scientific publications issued during that period with brief criticism.

BY W. B. ARVIN

THE BIOLOGY OF DEATH. By Raymond Pearl, of Johns Hopkins University. Cloth, 275 pages, illustrated. Lippincott, Philadelphia.

Death is one of the happenings of life, so much a cause of emotion that the ordinary layman rarely considers it as a subject for scientific research. Therefore, his fund of knowledge regarding it is more or less limited and there is very little scientific discussion of it outside the medical journals. This little volume from Lippincott's will be of great interest to the layman as well as to the biologist who is interested in getting at the scientific reasons for death.

It is very interesting to find that the author claims that the cells which go to make up the body are in their nature immortal. It is plainly set out and proven that there is no necessity for death. The immortal protozoa which reproduces itself by fission, i.e., dividing itself into two new individuals, is undeniably deathless under proper conditions. From a great many observations in the biological laboratory is brought the proof that almost all cells are immortal.

Then he advances his theory as to death. It is, plainly put, that the cells of the body have lost some of their ability of adaption in the process of evolution. It is the price the more highly organized and complex machine pays for its superiority. With the specialization of the various organs of the body the cells of the organs have become interdependent and some of them are weaker than others, being unable to reproduce themselves without aid. Though death is a thing really foreign to them many of the types haves lost the ability to reproduce their kind when destroyed by accident or other causes.

The attitude of the author is purely scientific, as can be seen by his discussion of immortality in the very beginning of the book. He says: It (belief in spiritualism) opens the way for recurring mental epidemics of that intimate mixture of hyper-credulity, hyper-knavery and mysticism which used to be called spiritualism but now prefers more seductive names. We are at present in the midst of the most violent and destructive epidemic of this sort which has ever occurred. Its evil lies in the fact that in exact proportion to its virulence it destroys the confidence of the collective mind of humanity in the enduring efficacy of the only thing which the history of mankind has demonstrated to contribute to the real advancement of his intellectual, physical, spiritual and moral well-being, namely the orderly progression of ascertained knowledge—science.

THE COMING OF THE FAIRIES. By Sir Arthur Conan Doyle. Cloth, 196 pages. George H. Doran Co., New York.

This book, and a good healthy sized volume it is, is based on three or four pictures taken by two girls living in the north of England. The pictures are reproduced in the volume and show the two girls playing in a dell with small figures, six or seven inches high, that are alleged to be fairies. They do look like the pictures we used to see as children in the picture-books. But, obviously, there is quite a difference between pictures of fairies in books for children not yet of the school age and the same subjects as the basis for a 196 page pseudo-scientific discussion.

That is one of the best things about Sir Arthur's discussions on things which seem, to us, impossible. He assumes a strict scientific air and maintains it with some success so that all the time one is reading what palpably is more or less delusion, one's conscience isn't bothered since the text is good old scientific discussion. The building of proof is logical even if from a false premise.

Following a very detailed account of how the pictures were taken (and photographers interviewed by this department said that they were easily faked) Sir Arthur gives a long account of letters he received from persons in various parts of the world telling how they had seen and played with fairies. The final pages of the book give a Theosophical discussion of the place of the fairies with regard to the other things in the spirit world.

"The Coming of the Fairies" is hardly a fair title. According to the book they are here, but it takes a sort of mediumship to see them. But belief in the book's bunk or truth depends entirely on the views of the reader. Understand, we do not say that the fairies were not seen. Quite the contrary, we once knew a man who said (and acted as if the statement was true) that he saw a blue and white polka-dot elephant playing ping-pong on the Broadway side of the Woolworth Build-

(*Continued on page* 1138)

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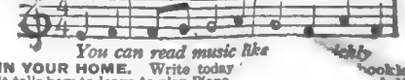

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Perhaps even now you have splendid ideas for inventions but the only reason you have not developed them is because you doubt your own ability to invent. Or, like most persons, you believe that you were not born to be an inventor; that inventors are men who invent things as naturally as other people work as bookkeepers, mechanics, doctors or farmers.

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Book Review

(*Continued from page* 1136)

ing. We are of the opinion that he was deluded, but the fact remains that he "may have seen" such an elephant, before they took him to the inebriate ward.

SCIENCE REMAKING THE WORLD. By Otis W. Caldwell and Edwin E. Slosson. Cloth, 282 pages, illustrated. Published by Doubleday, Page and Company, New York.

During the summer of 1922, nineteen men—scientists—gave a course of lectures at the Teachers College of Columbia University, looking toward giving the students at the school a real appreciation of the marvels of modern science and what it has done for the world. This book is a compendium of the lectures.

There is a general chapter at the opening of the book that is intended to give the reader a clear idea as to the place of science in the system of the world's values. Each of the lectures following deals with a different branch of science and in many cases with a restricted field. The forms of all of them are more or less the same, each gives a short history of the development of the field, sketches of the lives of the important men in the investigations concerned and a general outline of the work and the advancement gained.

Among the subjects treated are: Gasoline as a World Power, The Influence of Coal Tar on Modern Industry, Electrons and How We Use Them (a most interesting chapter), Influenza, Public Health, Chemistry and Food, Insect Sociology, and a number of others.

The book is recommended both as pure entertainment and for its educational value.

"THE GIRL ON THE GOLDEN ATOM." By Ray Cummings. Cloth, 341 pages. Harper and Brothers, New York.

Mr. Cummings needs no introduction to the readers of SCIENCE AND INVENTION who have followed his many interesting tales. In this volume, a chemist discovers a method of reducing the size of the cells of the body without destroying their inter-relations or their relative functions. These researches are made after he has seen a girl on an atom in a golden ring with the aid of an ultra-microscope. After he had seen her and watched her for a short time the peculiar effect of the light on the newly discovered lens used in the microscope causes it to explode. Since he was unable to watch her further he made the research for the compound that would enable him to reduce his size sufficiently to visit her.

He does—but a recounting of his adventures in doing so would be poaching on the author's ground. It is a rattling good tale.

THE BOOK OF THE STARS FOR YOUNG PEOPLE. By William Tyler Olcott. Cloth, 410 pages, fully illustrated. Putnam's, New York.

Realizing the value of the fable in helping a child—or a grown-up, for that matter—to better remember the thing with which the story is connected—the author of this book has connected the old fables of the stars with the various constellations which they represent. The book is formed of a number of chapters, each dealing with a different set of stars and the stories connected with them. There are also added chapters on the planets with a short description of each and a comparative size chart. An explanation of the movement of the stars in the heavens is given.

VISUAL ILLUSIONS AND THEIR APPLICATIONS. By M. Luckiesh. Cloth, 252 pages, illustrated. D. Van Nostrand Co., New York.

It is always an extreme pleasure to read one of Mr. Luckiesh's books. Besides being an authority on all things connected with light and lighting and the illuminating practice, he has a way all his own of putting the facts and observations together that make it a great pleasure to read his works. The present volume deals with the production of illusions and how they may be applied in industry and the home.

The numbers of illusions that affect the everyday life of the ordinary man is astounding. One of the most peculiar facts about it is that they pass unnoticed for the most part until they are called to the attention of the observer. There is an introductory chapter at the beginning of the treatise dealing with the eyes and its formation leading to a short discourse on its method of working in relation to the subject at hand.

There are divisions on architecture, color, angle effects, irradiation and a number of others. Each one is taken up in its turn. The final chapter of the book is one of the most interesting. It is on "Camouflage."

(*Continued on page* 1140)

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Book Review

(*Continued from page* 1138)

CAMP SITE AND AIRPLANE LANDING GUIDE. Compiled by the United States Touring Information Bureau for the National Aeronautical Association. Cloth, 115 pages with map. Published by the Touring Information Bureau Waterloo, Iowa.

This little book which will handily fit the pocket contains a full list of camp sites of the United States for the use of tourists and a complete list of landing fields for airplanes. A complete general map of both services is found at the rear of the book. The camp site list carries the population of the town, the facilities at the camp, the charges made, if any, and the nature of the town's scenic offerings. The airplane landing guide tells the dimensions of the fields, where the fields are located, the direction from which they must be approached, if they require a special line of approach, and much other information useful to aviators. The position of wires, roads, gulches and other impediments that might hinder the flier are also listed, and also the distance, from the field to the nearest base of supplies.

ANALYSIS OF THE INTERCHURCH WORLD MOVEMENT REPORT ON THE STEEL STRIKE. By Marshall Olds. Cloth, 475 pages. G. P. Putnam's Sons, New York.

This volume is a long and very detailed study of the report made by the Interchurch Movement on the general steel strike some years ago. The author takes up each phase of the report, point by point, and calls attention to certain alleged mistakes and generalities that he says appear in its pages. As is the case with all questions where there is so admittedly two sides, there is little chance of arriving at any definite conclusion as to evidence. It's a matter of personal opinion. Where one person would praise the Analysis another would say that the author stood on a technicality. The same situation obtains in reviewing the report. There is no doubt that there is much food for thought in the volume to the erudite student of the economics of labor and the present industrial system as it is viewed by both sides, but as a book for the general scientist, it is a little too tedious.

THE HONESTY BOOK. Cloth, 56 pages. Published by the National Honesty Bureau, 115 Broadway, New York. The name of the National Surety Company is also attached.

This volume, designed primarily as a teacher's hand-book, was produced as a result of the recent agitation for a course in honesty in schools, as one of the surest methods of combating the crime wave that has passed over the country more or less continually since the close of the war. The book simply sets out ways and means by which the teacher may impart honesty to the boys and girls under her care.

Divided up into a number of sections, the authors make every section bring out some important point with regard to the value of honesty. The attempt is to show the absolute value of honesty and its necessity as the foundation of all business.

In some of the chapters the stories printed for the use of the teacher are a little too sticky-sweet. However, this fault with the book may be ameliorated if the teacher is up to his business and has a real interest in the virtue, as such.

THE INVENTOR'S UNIVERSAL EDUCATOR. By Fred G. Dieterich. Cloth, 9 x 6 inches, 159 pages, illustrated. Published by the author, Washington, D. C.

This little volume contains a whole budget of information that will find excellent usage with inventors and near-inventors. It begins at the beginning by telling just exactly what a patent is and the best method of obtaining it. There is a long list of things not to do which, if followed, will save the inventor a lot of time and worry as well as a maze of legal confusion.

In the center section of the book is a large list of mechanical movements, nearly nine hundred of them.

No book on inventions and patents is complete without the chapter on what not to invent. This warning, it seems, will never be out of date with the inventors. The chapter of warning in the present volume is a very sensible one and, if the reader takes it to heart, will save him many useless days.

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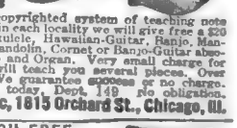

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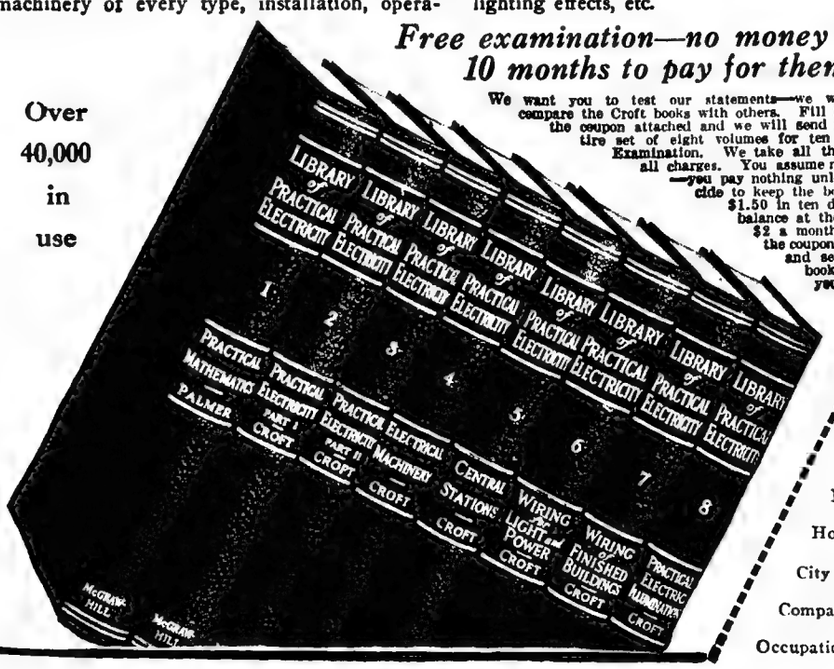

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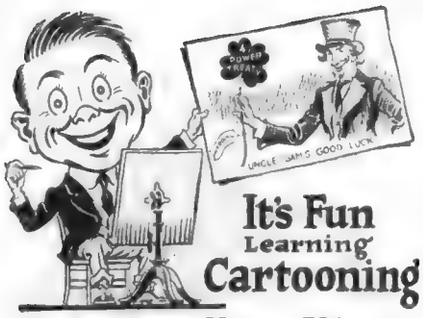

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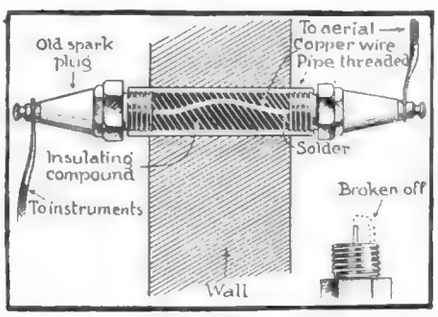
RADIO WRINKLES

EDITED BY
A. P. PECK,
Associate Member Institute Radio Engrs.

UNDER this heading we are going to publish items of interest to everyone who likes to build radio instruments. In order to continue this department it is necessary for our readers to tell us about their latest experiments. Write us a short description of some time- or money-saving kink you have discovered and send it to us along with a few sketches. Our regular prizes will be paid for this material. Be brief and try to put everything in the drawing. Don't be too elaborate. Address "RADIO WRINKLES" editor, care of Science and Invention.

LEAD-IN INSULATOR



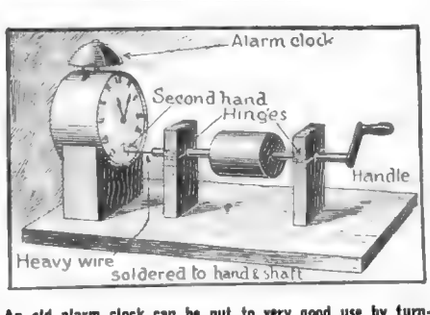
Two old half-inch spark plugs and a length of iron pipe threaded on the inside, at each end, with the same thread as the spark plugs, make an excellent and efficient lead-in, the ground terminals of the spark plugs are broken off and a heavy piece of copper wire connected between the center terminals —Carl R. Griesbocher.

Send On the Wrinkles

Come on fellows—and young ladies too for that matter—send in your Radio Wrinkles, but first let us caution you against one thing. That is, try to get away from the multitudinous verniers. It seems that in every mail, 90 per cent of the RADIO WRINKLE entries are some type of vernier. If the entries in the contest can be taken as a criterion, every set in the United States and foreign countries must be equipped with at least sixteen different types of verniers for condensers, vario-couplers, variometers and rheostats.

We want to make these columns as interesting as possible to the majority of people. Therefore, try to think up some new and original kinks for use on your radio set and send us a short description and a clear drawing in ink. You may be sure that if your idea is good, you will be amply repaid. For evidence of this fact, just turn back the pages of this magazine to the announcement of the awards in the $12,000 prize contest. Note how many wrinkle entries have been awarded prizes which are much larger than our usual space rates. Try to give us something really new.—Editor, Radio Wrinkles.

TURN COUNTER



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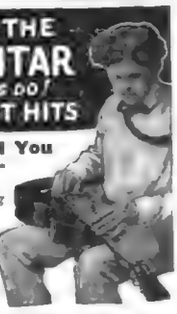

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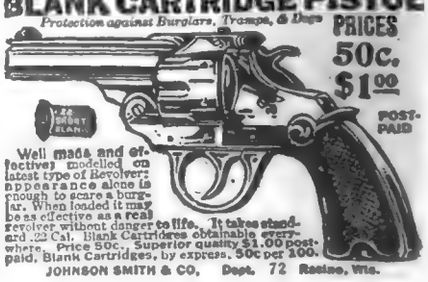

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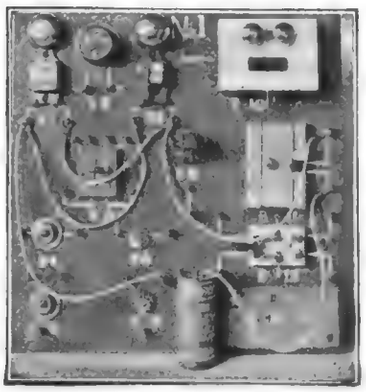

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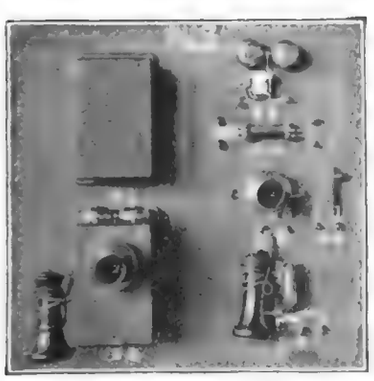

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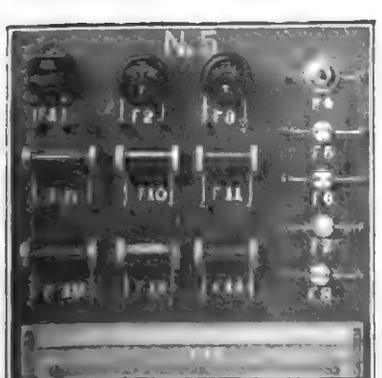

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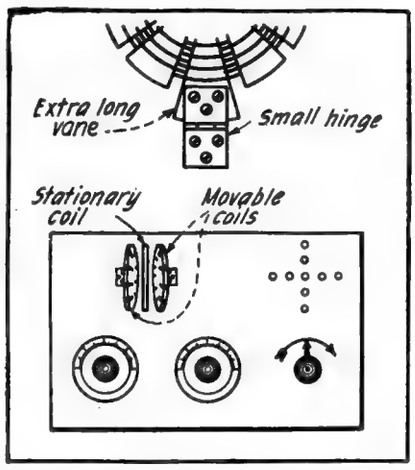
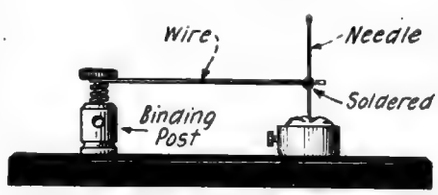
SPIDER WEB COIL MOUNTING



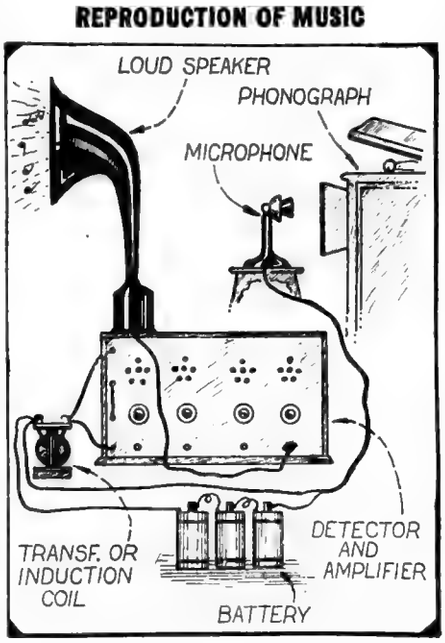
Small brass hinges such as used on radio cabinets and other small boxes may be pressed into service as spider web coil mountings with very good results. Small rivets or machine screws and nuts may be used to fasten the hinge to the coil as shown above, while the other end of the hinge is mounted on the panel. Connections may be made by flexible leads brought through holes drilled in the panel. —N. S. Mitchell.

A CAT-WHISKER KINK



The point of a steel needle makes an excellent contact for galena or other crystals requiring a fine point. A very simple detector may be made, making use of this fact, as illustrated above. A fairly stiff piece of copper wire is bent so that it can be held under the top of a binding post and to the other end of it is soldered the needle. The pressure between the point and the crystal can be regulated by bending the stiff wire.
—Arthur D. Smith.

REPRODUCTION OF MUSIC



Here is a new use to which you can put your radio loud speaker and amplifier, when you do not desire to use it on your radio set or circumstances prevent its use. They should be hooked up with the re[illegible] and "B" batteries and a modulation transf[illegible]n coil connected to the input binding [illegible]ttery and microphone as illustrated. [illegible]ien placed in front of a phonogra[illegible]he music played by the phonog[illegible]d through the loud speaker with [illegible]

(Continued on [illegible])

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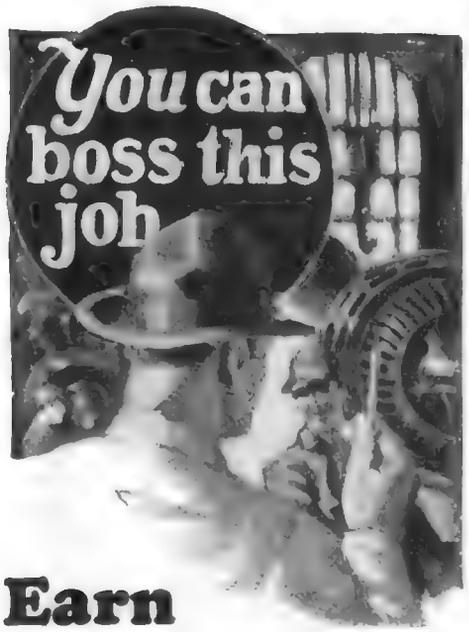

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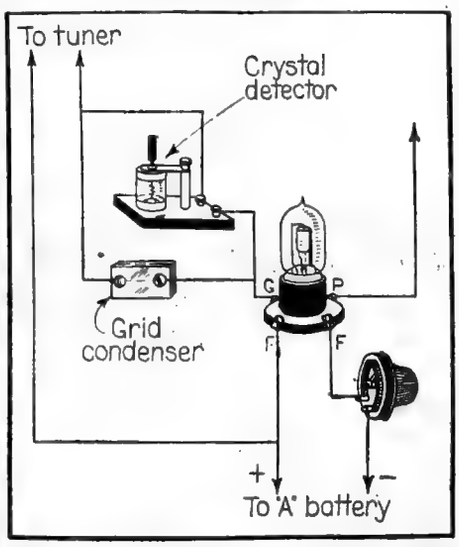
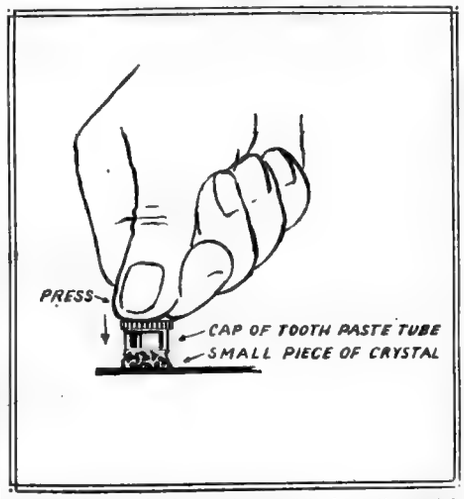
Crystal As Grid Leak



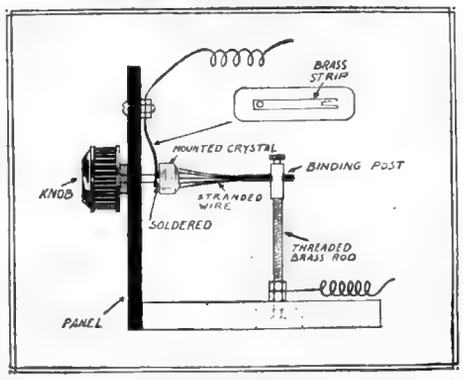
In the course of experimenting it was found that a crystal detector, when connected across a standard grid condenser as shown in the above illustration gave excellent results as a grid leak. The catwhisker was moved over the crystal until the best results in the operation of that particular tube were found. —Leroy Western, Reporter 15.

Mounting Crystals



The usual method of mounting crystals in molten metal very often destroys their sensitivity and renders them unfit for use in a radio receiving set. This can be avoided by mounting the crystals without the use of heat. A very good method for doing so is illustrated above. The crystals are chipped down so as to be slightly larger than the mouth of the cap of a tooth paste tube. The crystal is then placed on a hard flat surface with the cap on top of it. Pressure with the thumb will usually be found sufficient to force the crystal into the cup as the latter is made of very soft metal. If this pressure is not sufficient, a few light taps with a hammer will suffice.
—Francis Shiner.

Panel Mounted Crystal Detector



A very good adjustable crystal detector may be mounted in back of a panel and still be adjustable by following the suggestion illustrated above. A piece of stranded wire is used as the catwhisker and is fanned out at one end so as to make contact with several points on the crystal. Turning the knob slightly will cause the catwhisker to move over the surface of the crystal and adjustment is thereby made. —Dale Pollack.

(*Continued on page* 1148)

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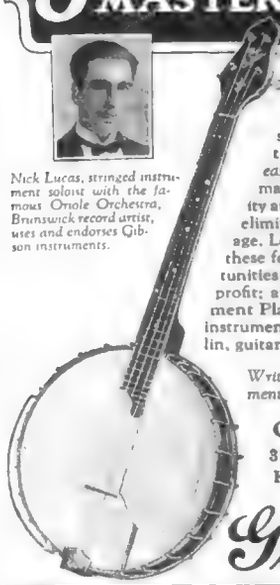

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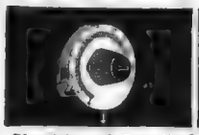

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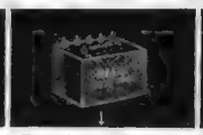

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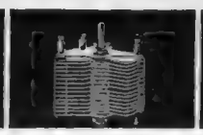

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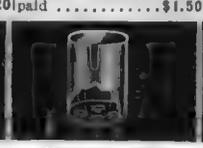

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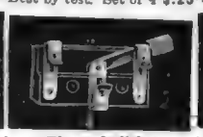

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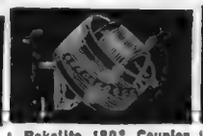

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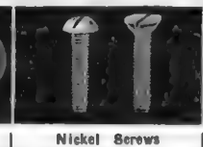

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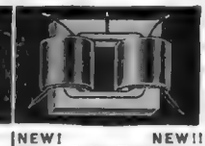

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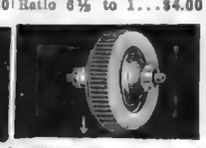

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1—M1000 Double Clr. Jack .65
8—M201 Binding Posts... .80
8—M6000-8 Binding Post Name Plates .... .24
24 Ft. M6400 Bus Bar Wire .60
Blue Prints and directions for assembling.. .50
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Reinartz Circuit

1—M710 Mahogany Cabinet 7"x10" $2.60
1—M7100 Dilectryte Panel 7"x10"x3-16" .. .70
1—M2660 Reinartz induct. (225 to 600 met.) 1.90
1—M6500 Vac. Tube Socket .35
1—M4310 6 ohm Rheostat .45
2—M2121 21 Plate Variable Condensers 2.50
1—M5059 Grid-Leak Condenser ..... .30
8—M201 Rasco Bind. Posts .80
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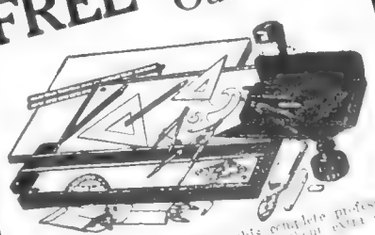

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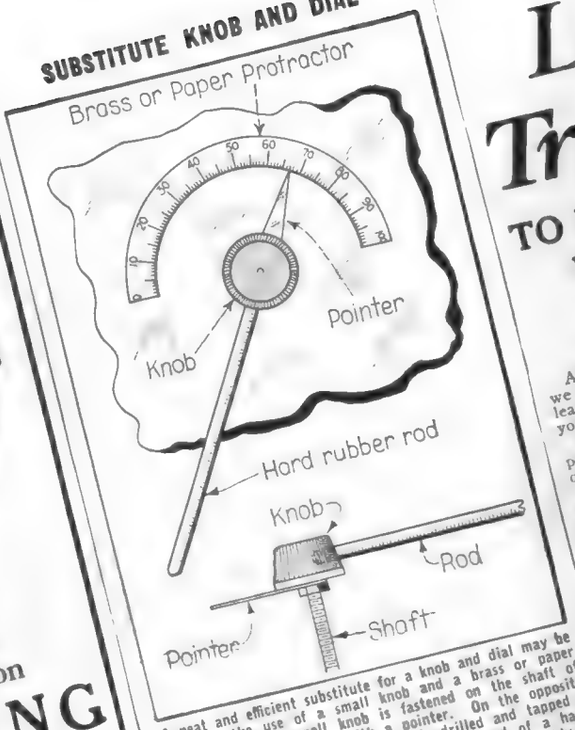
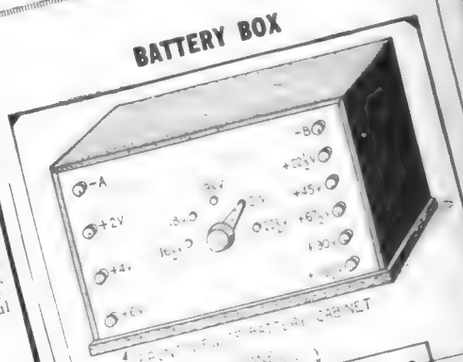
SUBSTITUTE KNOB AND DIAL



A neat and efficient substitute for a knob and dial may be made by the use of a small knob and a brass or paper protractor. The small knob is fastened on the shaft of the instrument together with a pointer. On the opposite side of the knob from the latter is drilled and tapped a hole. Into this is screwed the threaded end of a hard rubber rod about 4 inches long. The entire assembly is illustrated at the top of the above illustration.—L. W.

BATTERY BOX



A box of sufficient size to contain both "A" and "B" batteries is constructed and a panel provided for one side of it. On this panel may then be mounted binding posts and a 5 point switch. If a storage battery is used, taps may be taken at each jumper so that from 2 to 6 volts may be used as desired. One tapped and 4 untapped "B" batteries are necessary to produce 112 volts. The positive pole of the tapped "B" battery must be connected to the next one in line. This is not

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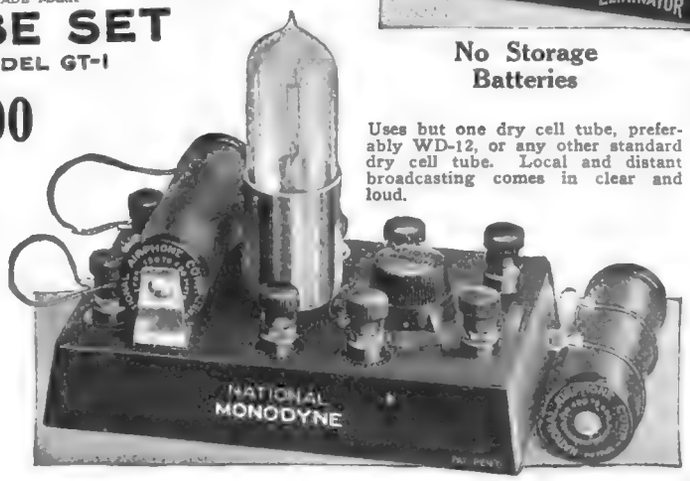

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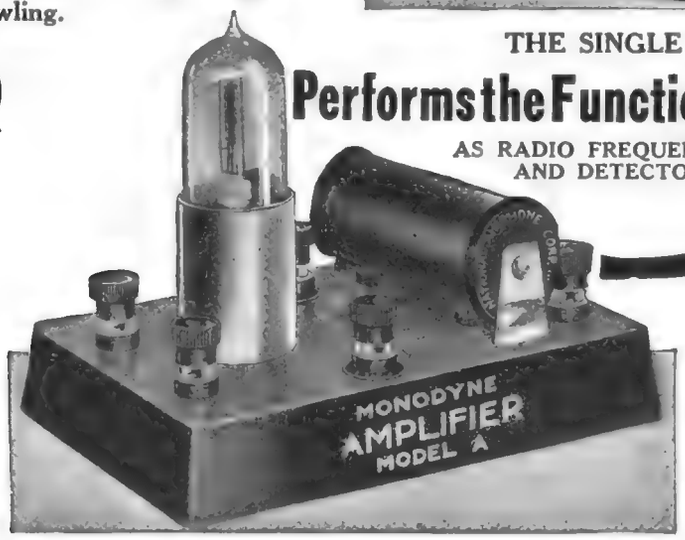

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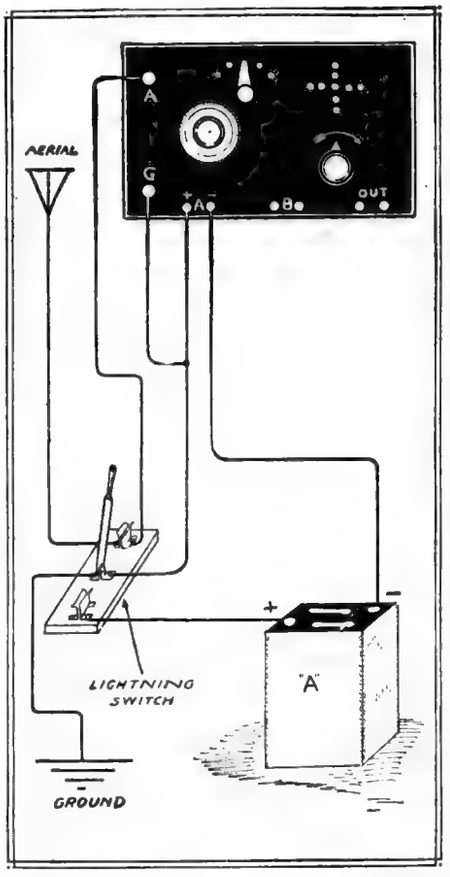
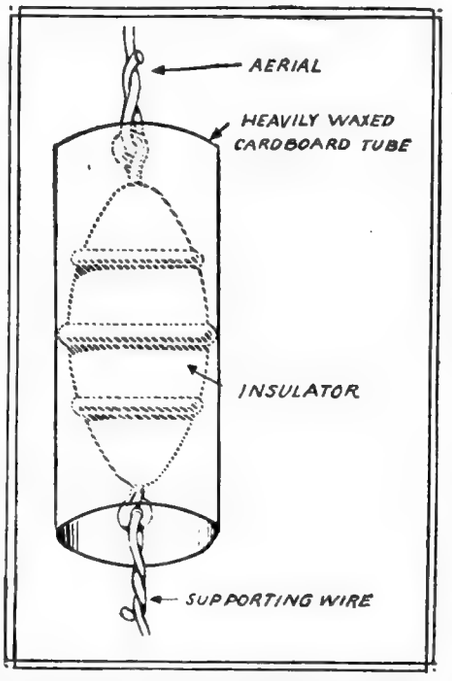


Two things that are very often forgotten when the operator leaves the receiving set are to ground the aerial and to turn off the filaments. In order to eliminate both of these troubles at the same time, the writer contrived a circuit whereby the lightning switch controls both the filament circuit and the aerial and ground. The circuit is shown above. By throwing the lightning switch to the jaw which is connected to the antenna, the latter will be grounded. By pulling the switch to the other side, the antenna will be left connected to the set as will also the ground, and the filament circuit will be closed at the same time. —L. W.

PROTECTING ANTENNA INSULATORS



In a severe rain or snow storm the insulators on a receiving antenna become coated with moisture and allow leakage to the ground. This can be eliminated by placing over the insulator a heavily waxed cardboard tube of sufficient length to extend beyond the eyes on the end. —Carl Thorsell.

(*Continued on page* 1152)

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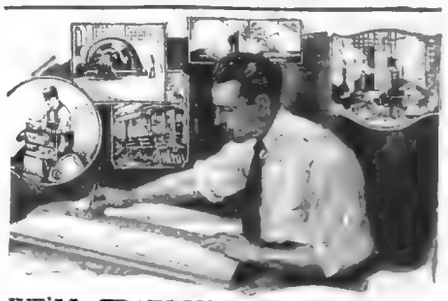

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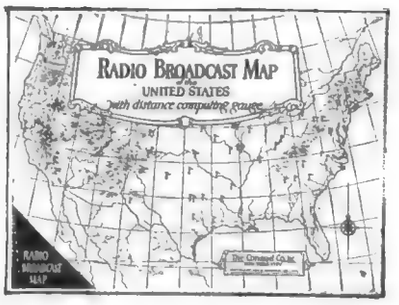

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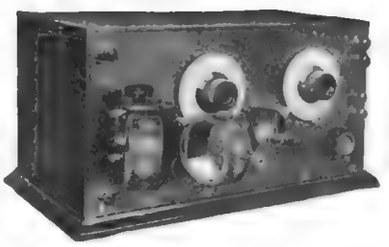

Another important feature is that the set tunes sharply, which is one of the utmost requisites of an ideal receiver.

The packet consists of blue prints for drilling the panel, wiring the apparatus, and a four-page instruction pamphlet giving complete details as to the parts required, tools needed, and even how to tune.

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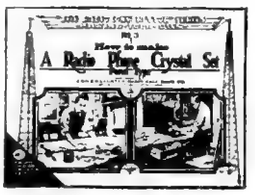

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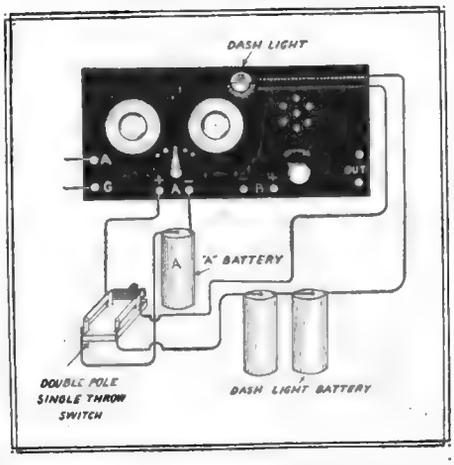
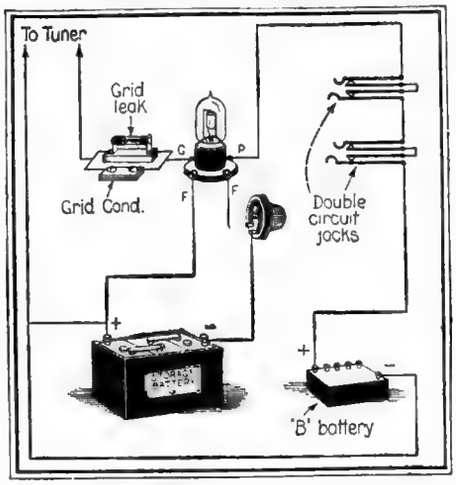


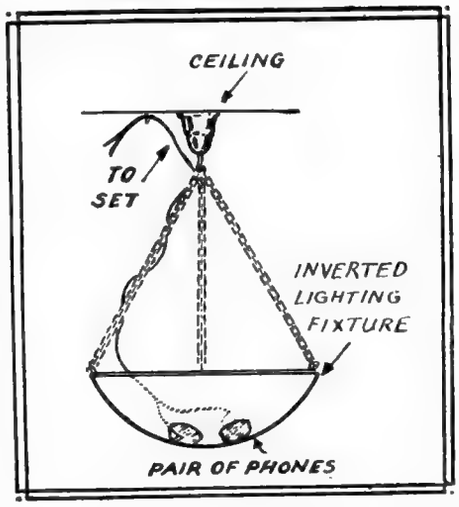
The latest fad in the line of decorations for radio sets is an automobile dash-light to illuminate the panel. This was described some time ago in this magazine. Above is shown a circuit diagram, whereby a double-pole single-throw switch controls both the filaments and the dash-light. —Gerald Meyer.

MULTIPLE PHONE JACKS



On the majority of receiving sets, when it is desired to connect into a circuit two or more pair of head phones, it is necessary to remove the phone tips from binding posts and take off various jumpers. However, if it is decided that a certain number of phones are to be connected in series, as many jacks as there are pairs of phones may be mounted on the panel and connected in series as illustrated above. —E. Fralic, Reporter 930.

NOVEL LOUD SPEAKER



An inverted lighting fixture may be made to act as a loud speaker by removing the sockets therefrom and placing in the bottom of the bowl a pair of phones. They should be arranged with their caps upward. A little experimenting with this idea will produce a very satisfactory loud speaker. —Ralph Snyder, Reporter 1685.

(*Continued on page* 1157)

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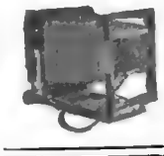

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"Then there is the case of Dr. Warsaw, who weighed 240 pounds and was not well. Also for a year he had had a stubborn bronchial trouble which had prevented him from singing. This was a great trial to him, for he had long been an accomplished singer.

"He took the new treatment for eight hours. At the end of that time he had lost fourteen pounds, and his waist measure had been reduced two inches. He was so light on his feet that he could leap over the table on which he had been lying. And—this is the *most wonderful part of it—he had his voice back.* With my own ears I heard him render the Prologue from Pagliacci perfectly. He is a man of seventy."

You owe it to yourelf to learn all you can about this amazing discovery—which washes away your years, your ills, your aches, your extra pounds; which makes you feel the thrill of renewed desires and impulses, and tunes your body once more to the call of Youth.

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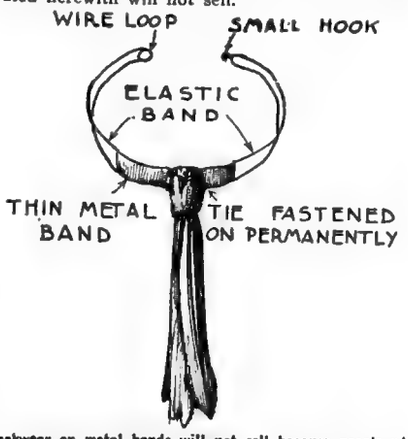
Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

A TIE FORM

(780) Rudolph Wensko, Cleveland, Ohio, would like to know why a tie form such as illustrated herewith will not sell.



Neckwear on metal bands will not sell because people who buy them are usually a laughing-stock. Many types are on the market at present.

A. If you had wandered around the streets of New York and perhaps Cleveland, you would have seen forty or fifty different devices in the form of wire hooks, elastic bands, spring metal fasteners and bow-ties with hooks in the back or sides, for use with full dress suits, all incorporating the idea which you have advanced. None of these devices sell except for a very short time. The suggestion, therefore, is as old as the proverbial hills.

The reason why people do not care to buy forms to which to secure their ties is because of the fact that these forms are liable to slip, break or otherwise open, and when they do the man wearing the same becomes the laughing stock of the crowd.

We frankly do not believe that you could secure a patent upon your device, and even if you could, we would advise against patenting the same.

SHIP PROTECTION AND TYPEWRITER RIBBON

(781) D. Davis, Chillicothe, Ohio, submits an idea for a chain mail armor for the protection of battleships, which consists of armor to be placed around battleships to protect them from torpedoes. He also requests our opinion on a typewriter ribbon saturated with luminous and sympathetic ink.

A. A chain mail armor for the protection of battleships is not new, and we doubt very much that you could obtain a patent on the system. Such armor only retards a ship, and does not protect it to any great extent. The U. S. Navy had their ships equipped with torpedo nets and they were seldomly if ever employed.

We believe that a demand for a typewriter ribbon saturated with luminous ink could be made. An immense amount of experimenting will be necessary, however. A ribbon saturated with cobalt chloride will not be of any particular value because the writing will be visible, due to the impression made by the keys upon the sheet. We doubt that the luminous ink will leave a permanent impression on the paper, inasmuch as very little of this could be made to adhere to its surface when the typewriter keys strike the ribbon. This is where your experimenting must begin.

TIDE MOTOR

(782) J. S. Edwards, Elberon, Va., has submitted an idea of a tide motor and system. Two baffle gates will close a double walled channel permitting a flow of water to pass in first one direction as the tide is rising, and then again in the same direction after swinging the gates over into their opposite position, when the tide is ebbing. Consequently, a turbine placed in the middle of this channel will continue to rotate in the same direction. He asks our advice concerning the practicability of the system.

A. Although your proposition is feasible, the cost of installing a device such as you describe, will be so great and its effectiveness so slight, that we would hesitate at advising a patent upon it. You must remember that although you do get a vast amount of water flowing into a cove or bay, the effective pressure of this water is very slight because the water has no drop; consequently no pressure. Slow acting turbines would have to be used to drive generators, but the generators would develop a relatively small amount of power. It is much better to use water from falls than to employ the system you have designed.

We do not condemn your idea in its entirety. The main reason for our denunciation of this scheme is because of the terrific cost of installation together with its very slight productive value.

STENOGRAPHIC ENDLESS RECORD NOTE-BOOK

(783) Constantine Troy, Elmira, N. Y., has designed a device for moving a roll of paper beneath a stenographer's fingers. Through a slot in the box containing the electrical motor she writes upon the paper roll. The same mechanism is used

A stenographer's note book, the paper of which is on an endless roll operated by a motor is hardly practical.

for transcribing the notes. The motor speed is controlled by a rheostat.

A. Your idea for controlling paper for stenographers is not of any particular value. A machine for work of this nature would be so bulky, so extremely undesirable, that there are few, if any, stenographers who would use the same, and no concern would contemplate installing the system. What would happen should the dictator hesitate or stop to answer a phone call can only be imagined.

CUE CHALKER

(784) Rudolph Wensko, Cleveland, Ohio, has designed an electrically driven cue chalker. He asks our advice concerning it.

A. Unless you can manufacture the cue chalker yourself, sell it at a ridiculously low price, prove to the billiard and pool parlor owners that it effects an actual saving of chalk and will pay for itself in so and so many months (which figures must be obtained by yourself) we hold very

(*Continued on page* 1156)

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CLARENCE A. O'BRIEN

PATENT ATTORNEY

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EARLE E. LIEDERMAN as he is today

If a Jelly Fish Could Slap a Rat in the Face

he would do it. But he can't. He has no arms. Neither does he have a backbone. How much worse off is a man who was given a good backbone and a pair of arms—and won't use them.

No Excuse

We excuse the jelly fish. He never had anything to work on. But there is no excuse for a flabby, round shouldered and flat chested specimen of a man. You were given a perfect framework for a body. You were meant to rule the world, but there is hardly an animal alive which does not show better sense than you do.

Cut It Out, Fellows

Brace up and be the man you were meant to be. Don't try to imitate a jelly fish. Get some pep into you and make a real *he* man out of yourself. Come on and let me help you. I'll shoot a thrill into you that will make your old spine quiver with excitement. I'll build up that chest, broaden those shoulders and give you the huge, muscular arms of an athlete. And that's not all. Your lungs will start pumping real oxygen into your blood, purifying your entire system. Those old cobwebs in your brain will disappear. Your eyes will radiate the life within you. You will have a spring to your step, and every move you make will show new life and energy.

It's Not Too Late

I don't care what your present condition is. The weaker you are, the more noticeable the results. All you need is a framework and enough ambition left to say "I'm ready. Let's go!" I'm going to put one full inch on your arms in just 30 days. Yes, and two inches on your chest. But that's only a starter. Then watch 'em grow. I'll put pep into your old backbone and build up every muscle on your body so that your own friends won't know you. This is no idle talk, fellows. I don't promise these things—I guarantee them. Make me prove it. That's what I like.

Send for my 64-page book

MUSCULAR DEVELOPMENT

It is Free

It contains forty-three full page photographs of myself and some of my many prize-winning pupils I have trained. Many of these are holding down big jobs in their business professions today. I haven't only given them a body to be proud of but I've made them better doctors, lawyers, engineers, etc. Some came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present splendid physiques. Are you ready to be made over? Come on—let's go

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Sir: I enclose herewith 10 cents, for which you are to send me without any obligation on my part whatever, a copy of your book, "Muscular Development."

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Patent Advice

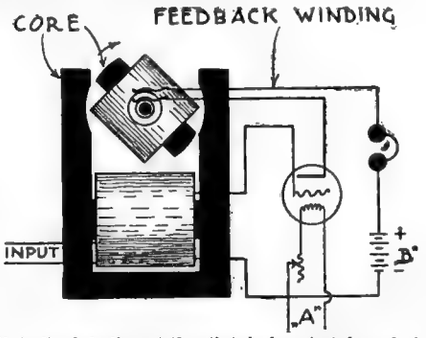
(*Continued from page* 1154)

little hope for the system. If you cannot manufacture it and intend, mainly, to get a patent with the possibility of selling the rights, we believe your chances of even making it pay are nil.

We would advise, in any event, that you proceed with such exploitation very carefully. You should first find out whether or not proprietors of billiard and pool parlors are interested in your device.

RADIO TRANSFORMER COUPLING

(785) Martin C. Truska, Brooklyn, N. Y., has designed a transformer for radio circuits in which he expects to get regeneration, due to change of position of a coil on one leg of an iron core.



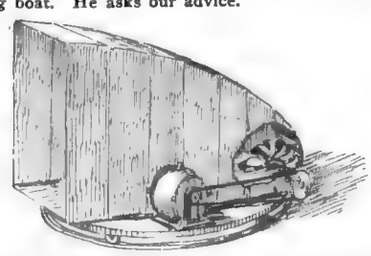
It is the inductive relation that is important in a feed-back transformer and not the magnetic relation of the two coils composing it. The above idea is valueless.

A. We doubt very much if the audio-frequency transformer as designed by you will do anything but cut down the strength of the signals, for the simple reason that you are merely building a transformer with a magnetic leakage gap. This transformer is of but slightly different construction from the high tension transformers in which the gap is created by separating a section of the iron core in one corner of the transformer from the rest of the iron. This functions in much the same manner.

Consequently, your attempt at a feed-back winding will be absolutely worthless. Remember that a feed-back winding depends upon the inductive relation between coils, not cores, and, therefore, the magnetic relation obtained in your device will be worthless when an attempt at feeding back is made.

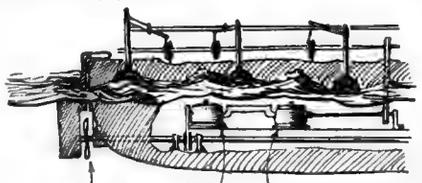
WIND AND WAVE POWER

(786) J. P. Matthews, Standardsville, Va., submits two diagrams, one for a power mechanism from the wind, and the other for a self-propelling boat. He asks our advice.



There is little that is novel in the wind motor shown in the above sketch. It promises to be very low in efficiency.

A. We do not see very much in either of the two ideas. There is nothing unusually novel in what you call the "windzany." The modern long vertical wind mills do not have to be faced to the wind. These operate regardless of which way the wind blows and are far superior to the "windzany" illustrated by you.



Propelling a boat by wave power with the aid of the apparatus shown is impractical, since the boat will also move with the waves and very little power will result.

Your description of the "waterzany" in which the water is supposed to lift the float up and down is by no means valuable because not only will the float move up and down, but the boat itself will rock; consequently, 99 per cent of the motion which should be transferred to the boat is lost. The result is that the boat will develop practically no power.

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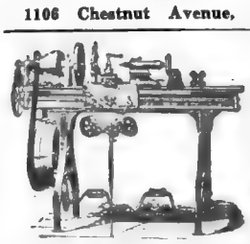

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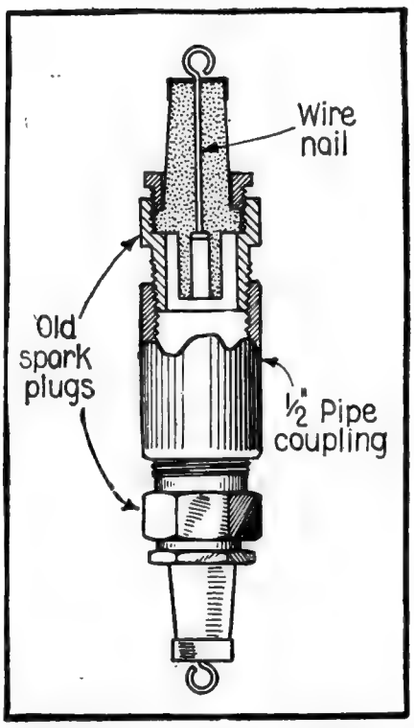

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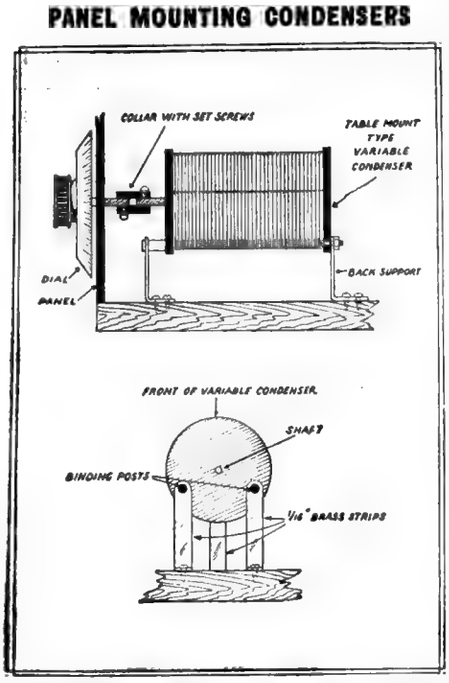
PANEL MOUNTING CONDENSERS



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If a Jelly Fish Could Slap a Rat in the Face

he would do it. But he can't. He has no arms. Neither does he have a backbone. How much worse off is a man who was given a good backbone and a pair of arms—and won't use them.

No Excuse

We excuse the jelly fish. He never had anything to work on. But there is no excuse for a flabby, round shouldered and flat chested specimen of a man. You were given a perfect framework for a body. You were meant to rule the world, but there is hardly an animal alive which does not show better sense than you do.

Cut It Out, Fellows

Brace up and be the man you were meant to be. Don't try to imitate a jelly fish. Get some pep into you and make a real *he* man out of yourself. Come on and let me help you. I'll shoot a thrill into you that will make your old spine quiver with excitement. I'll build up that chest, broaden those shoulders and give you the huge, muscular arms of an athlete. And that's not all. Your lungs will start pumping real oxygen into your blood, purifying your entire system. Those old cobwebs in your brain will disappear. Your eyes will radiate the life within you. You will have a spring to your step, and every move you make will show new life and energy.

It's Not Too Late

I don't care what your present condition is. The weaker you are, the more noticeable the results. All you need is a framework and enough ambition left to say "I'm ready. Let's go!" I'm going to put one full inch on your arms in just 30 days. Yes, and two inches on your chest. But that's only a starter. Then watch 'em grow. I'll put pep into your old backbone and build up every muscle on your body so that your own friends won't know you. This is no idle talk, fellows. I don't promise these things—I guarantee them. Make me prove it. That's what I like.

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Patent Advice

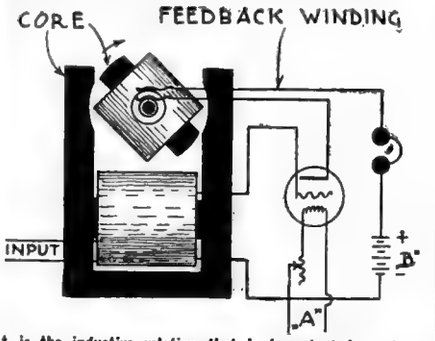
(*Continued from page* 1154)

little hope for the system. If you cannot manufacture it and intend, mainly, to get a patent with the possibility of selling the rights, we believe your chances of even making it pay are nil.

We would advise, in any event, that you proceed with such exploitation very carefully. You should first find out whether or not proprietors of billiard and pool parlors are interested in your device.

RADIO TRANSFORMER COUPLING

(785) Martin C. Truska, Brooklyn, N. Y., has designed a transformer for radio circuits in which he expects to get regeneration, due to change of position of a coil on one leg of an iron core.



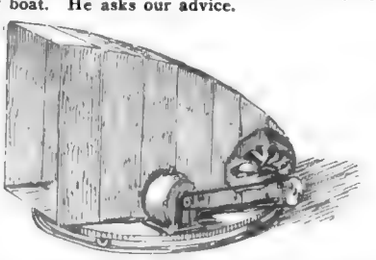
It is the inductive relation that is important in a feed-back transformer and not the magnetic relation of the two coils composing it. The above idea is valueless.

A. We doubt very much if the audio-frequency transformer as designed by you will do anything but cut down the strength of the signals, for the simple reason that you are merely building a transformer with a magnetic leakage gap. This transformer is of but slightly different construction from the high tension transformers in which the gap is created by separating a section of the iron core in one corner of the transformer from the rest of the iron. This functions in much the same manner.

Consequently, your attempt at a feed-back winding will be absolutely worthless. Remember that a feed-back winding depends upon the inductive relation between coils, not cores, and, therefore, the magnetic relation obtained in your device will be worthless when an attempt at feeding back is made.

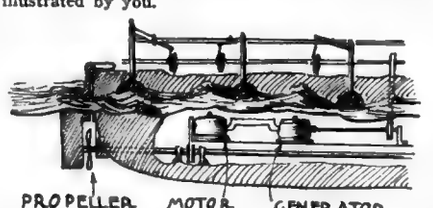
WIND AND WAVE POWER

(786) J. P. Matthews, Standardsville, Va., submits two diagrams, one for a power mechanism from the wind, and the other for a self-propelling boat. He asks our advice.



There is little that is novel in the wind motor shown in the above sketch. It promises to be very low in efficiency.

A. We do not see very much in either of the two ideas. There is nothing unusually novel in what you call the "windzany." The modern long vertical wind mills do not have to be faced to the wind. These operate regardless of which way the wind blows and are far superior to the "windzany" illustrated by you.



Propelling a boat by wave power with the aid of the apparatus shown is impractical, since the boat will also move with the waves and very little power will result.

Your description of the "waterzany" in which the water is supposed to lift the float up and down is by no means valuable because not only will the float move up and down, but the boat itself will rock; consequently, [illegible] cent of the motion which should be [illegible] to the boat is lost. The result is that [illegible] develop practically no power.

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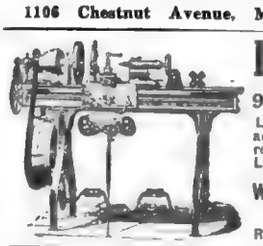

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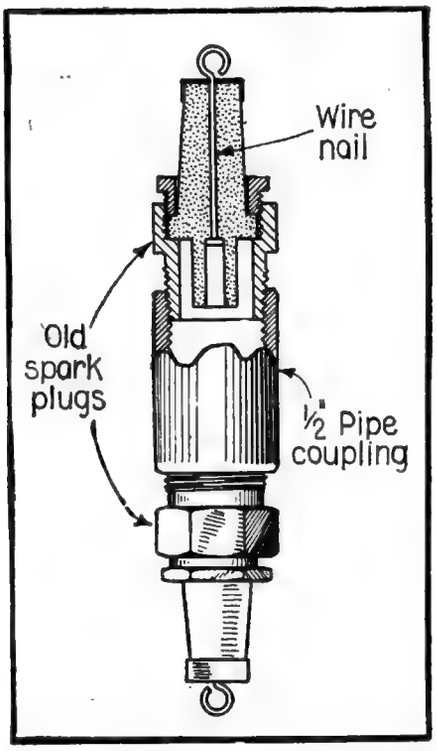

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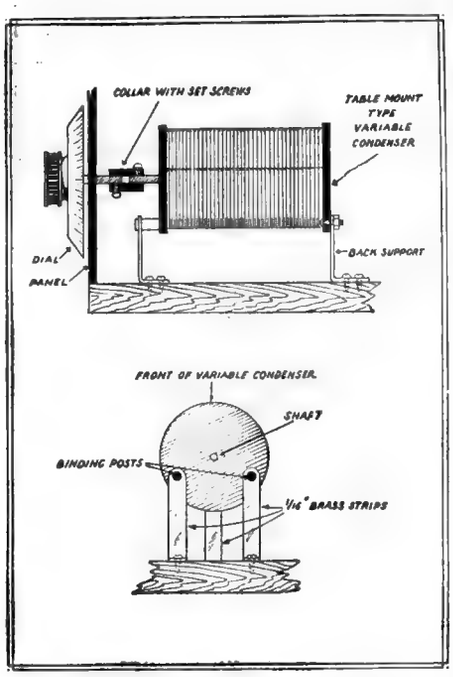

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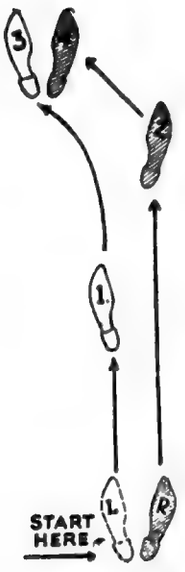

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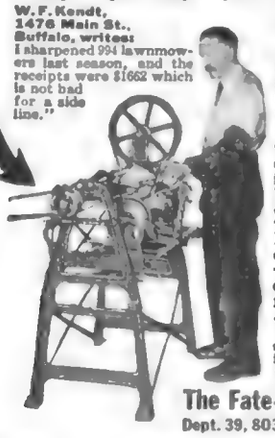

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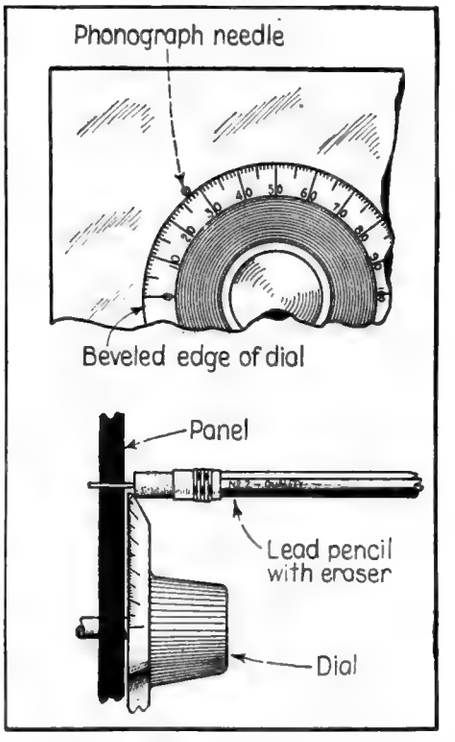
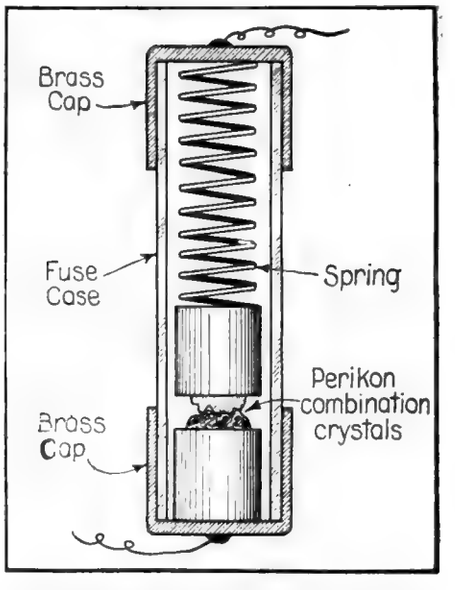
The Simplest Vernier



A vernier may be attached to any dial on a set at absolutely no expense whatsoever. The only necessary parts to fasten to the panel itself are as many worn out phonograph needles as there are dials. A pencil with an eraser on one end is then used as the medium for transmitting rotation from the hand to the dial. This is rather an old trick, but with the addition of the phonograph needle, it becomes very efficient. All that it is necessary to do is to place the eraser on the end of the needle and it will automatically come in contact with the edge of the dial. The pencil can then be turned carefully whereupon the dial will rotate slightly, giving the desirable vernier effect with the additional advantage of reducing body capacity.

—E. H. Kay, Reporter 1394.

Perikon Detector



In the course of experimenting with crystal detectors, a favorite combination of zincite and copper pyrites is very often found. This combination is usually sensitive practically all over the surface and gives excellent results. When such a combination has finally been found it can be mounted in a very stable form by following the illustration shown above. A burned out fuse of the tubular type is used as the case. The brass caps are removed and the interior cleaned out thoroughly. The base of one of the crystal mountings is soldered to one of the caps which is replaced on the tube. The other crystal is then placed in the tube so that the two will come in contact with each other. A fairly stiff spring is then inserted and the other cap replaced.

—P. W. Streeter.

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R171 Frost double set 3000 ohm $4.05
R162 Frost double set 2000 ohm $4.05
R163 Frost double set 3000 ohm $4.65
R172 Frost double set 3200 ohm.....$5.19
R166 Brandes Superior double set..$5.19
R167 Brandes Navy type double set $6.75
R168 Genuine Type C Baldwin Phones double set $10.50
R169 Genuine Type C Baldwin Unit with cord $5.15

BALDWIN LOUD SPEAKER ...$25.00

SPAGHETTI AND WIRE

R33 Per 4-Ft. length 27c
R32 Tinned Copper No. 16 Wire..Ft..1c
R34 Wire with insulation similar to spaghetti on it. Wire is tinned for soldering. Price 10 feet 29c

ERLA R. F. TRANSFORMER

Specify 1st, 2nd or 3rd stage.
R1500 Erla Transformer $3.40

ERLA REFLEX TRANSFORMER

R1650 Reflex Transformer.....$4.40

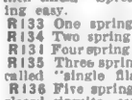
TESTED CRYSTALS

R12 Galena, per pkg. $0.10
R13 Silicon, per pkg. 10

JACKS AND PLUGS

Jacks are polished nickel, nickel-silver springs, pure silver contacts. Nickel washers for mounting on any panel ⅛ to ⅜ inch thick. Spread terminals make soldering easy.

R133 One spring (open circuit) ..$0.32
R134 Two spring (closed circuit) .. .42
R131 Four spring (two closed circuits) .50
R135 Three spring (two open circuits) called "single filament control")... .53
R136 Five spring (two open and two closed circuits, commonly called "two circuit filament control") ..... .69
R139 Plug with threaded barrel instead of set screw. Takes cord tips .45



VARIABLE GRID LEAK

Pencil mark type. Removable black enameled cap.
R50 Grid leak.....13c

GRID AND PHONE CONDENSERS

Mounting Holes spaced to fit screws of above Grid Leak. Mica insulation, wrapped with varnished cambric tape. Capacity, .00025 Mfd.

R55 Grid Condensers 6c
R59 Phone Condensers, .001 Mfd....15c

C. R. L. ADJUSTABLE GRID LEAK AND CONDENSER

A turn of the polished black knob will enable you to get the one and only one potential that provides the maximum signal strength. Made for panel mounting.
R107 C.R.L. Adjustable Grid Leak and Grid Condenser $1.49

FRESHMAN TESTED MICA CONDENSERS.

R62 .00025 mfd. Condenser $0.27
R63 .0005 mfd. Condenser $0.27
R64 .001 mfd. Condenser..... .31
R65 .002 mfd. Condenser..... .31
R66 .0025 mfd. Condenser..... .41
R67 .005 mfd. Condenser..... .65
R68 .006 mfd. Condenser..... .65
R69 .01 mfd. Condenser..... 1.37

FRESHMAN VARIABLE GRID LEAK AND GRID CONDENSER

For unbroken range—zero to 5 megohms, clarifies signals, lowers filament current, increases battery life, eliminates hissing.
R60 Freshman Variable Grid Leak and Condenser $0.85

AERIAL WIRE

R355 Copper 7 strand 100 ft. coil..$0.77
R356 Single No. 14 Bare Solid Copper Wire 100 ft. Coils 55

SWITCH POINTS AND STOPS

Brass, polished nickel finish. Screw size, 6/32x⅝ ins. long, 2 nuts with each contact point and one with stops
R158 Switch point ¼" dia.,⅛" high Each 2c Dozen 18c Hundred $1.05
R130 Switch Point diam., ⅜ inch; height, 3-16 inch ..... Each 2c Doz. 20c Hundred $1 40
R150 Switch Stops 2c 20c 1.40

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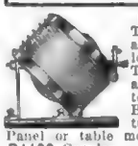
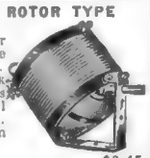
Your satisfaction guaranteed. If for any reason you do not feel satisfied with your purchase, you may return it and we will refund your money. We will pay return transportation charges.



180° VARIOCOUPLER

The primary and secondary windings of this coupler are properly spaced. The center of the secondary is always in the center of the primary field. Black base, brown formica tube and nickeled parts. Panel or table mounting.
R1100 Coupler $2.75

180° MOULDED ROTOR TYPE COUPLER

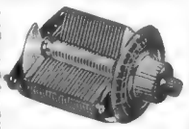


This 180° variocoupler has heavy black tube and moulded rotor. Wound with green silk wire and has 10 taps on the primary. Metal parts are brass nickel. Can be mounted on panel or table.
R1120 Variocoupler $3.45

VARIABLE CONDENSERS

Condensers are made of heavy aluminum plates, evenly spaced with high grade bakelite ends.
R1443 43 plate .001 Mfd. without dial $1.49
R1423 21 plates, .0005 Mfd. without dial 1.29
R1411 11 plates, .00025 Mfd. without dial 1.15
R1403 3 plates, .00005 Mfd. without dial ..... .98

VERNIER VARIABLE CONDENSERS

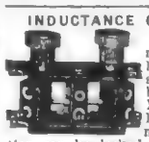


For fine tuning, neat appearance, this condenser is just the thing. Made of heavy aluminum plates and high grade bakelite ends. These condensers are furnished with neat appearing knob and dial.
R1444—44 plates vernier .001 Mfd. with dial $3.05
R1422—22 plates vernier .0005 Mfd. with dial $2.73

ERLA AUDIO FREQ. TRANSFORMER

R1750 Erla Audio Transformer....$4.40

INDUCTANCE COIL MOUNTINGS



For base or panel mounting. Connecting leads furnished, coil settings are adjustable by means of knobs. Made entirely of bakelite with nickeled brass metal parts. Coil position can be locked by knurled set screws
R1603 Three circuit mounting.....$3.75
R1602 Two coil mounting..... 2.70
R1601 Single coil mounting..... .37

INDUCTANCE COILS

Rigidly wound, nicely finished, low distributed capacity. All coils are equipped with standard mountings. We can supply any of these coils with or without mounting plugs. The wave lengths shown are range limits, based on variable condenser .001 mfd. capacity. Price un- mounted Price mounted

No.	No. of turns	Wave Lengths			
1725	25	125-	250	$0.34	$0.78
1726	35	175-	450	.38	.91
1727	50	240-	720	.44	.97
1728	75	390-	910	.49	1.03
1729	100	500-	1,450	.53	1.08
1730	150	800-	2,000	.58	1.12
1731	200	900-	2,500	.67	1.21
1732	250	1,200-	3,500	.73	1.30
1733	300	1,500-	4,500	.77	1.31
1734	400	2,000-	5,000	.92	1.52
1735	500	2,800-	6,100	1.07	1.58
1736	800	4,000-	10,000	1.22	1.73
1737	750	5,000-	12,000	1.38	1.88
1738	1,000	7,000-	15,000	1.65	2.19
1739	1,250	9,750-	19,500	1.87	2.39
1740	1,500	14,500-	26,500	2.13	2.53

INSULATORS

These are very strong strain type insulators. Each Doz.
R360 Moulded insulator shown $0.10 $1.10
R365 Porcelain insulators .. .09 .95

VARIOMETERS

For efficiency, perfect inductive ratio, low capacity effect and neatness of design these variometers are unexcelled. Metal parts nickeled. Stator and ball mahogany finish. Completely assembled.
R1200 Variometer ...$2.65
The above variometers knocked-down stator wires cemented in the stators. Rotors are wound. All metal parts included.
R1205 Knocked-down Variometers..$1.85

MOULDED VARIOMETERS

R1220 Moulded Variometer $3.95

DIALS

Genuine Bakelite Dial as pictured. Sharply engraved divisions and figures filled with a brilliant white. Set screws included.

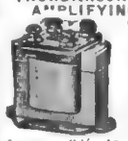
Bakelite Composition

R502 Dial, 2 inch, 3-16 in. shaft..$0.32
R500 Dial, 3 inch, 3-16 in. shaft.. .35
R501 Dial, 3 inch, ¼ in. shaft... .35
R504 Dial, 4 inch, ¼ in. shaft... .67
Moulded composition dial as pictured. Has a luster that cannot be told from Bakelite. Set screws included. Each
R563 Dial, 2 inch, 3-16 in. shaft..$0.16
R550 Dial, 3-16 in. shaft..... .22
R555 Dial, ¼ in. shaft..... .22

AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

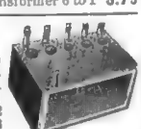
Correctly designed for minimim distributed capacity and low core loss. Shielded beautifully finished in nickel and black enamel. Ratio 5½ to 1.
R1506 Shielded Transformer $2.95

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMERS



There is probably no better known transformer. Made by a company that specializes in transformers. Entirely encased in sheet aluminum shield Heavy connecting straps to binding posts.
R1504 Thordarson Transformer, 3½ to 1.....$3.35
R1505 Thordarson Transformer 6 to 1 3.75

"B" BATTERIES



Standard high grade radio "B" batteries. Never over five days old.
R230 22½ volt Signal Corps type. Size 3⅝x2 x2¼ inches $1.18
R240 22½ volt large variable—5 positive taps. Size 6½x4x3 .....$2.25
R245 45 volt large size binding posts. Size 7⅞x6⅝x3 .....$4.50

INDUCTANCE SWITCH

For neat appearance and time saving, we suggest this inductance switch, as it needs but one hole in the panel to be mounted. Switch Points are mounted on this switch, 15 switch points, in all.
R1095 Inductance Switch $1.22

MAGNET WIRE

Quality magnet wire. We carry three types in stock. Each spool is 8 oz.

Size	Double cotton covered Price	Size	Green silk Price	Size	Enameled Price
R18	$0.40	R20	$0.76	R20	$0.37
R20	.52	R22	.90	R22	.47
R22	.68	R24	1.05	R24	.51
R24	.78	R26	1.18	R26	.56
R26	.88	R30	1.70	R30	.62
R28	1.02	R32	2.00	R32	.66
R30	1.40	R36	2.70	R36	.85

SWITCH LEVERS

A high grade, polished nickel-plated lever with solid moulded black composition knob. Complete with panel bushing.
R151 1 -in. Radius ..14c
R155 1½-in. Radius ..14c

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Order from this page. Please give number, description and price of the article you order to help us avoid mistakes. Total the amount of your order and send Post Office money order, certified check or draft with your order. Be sure to give your name and street address on both letter and envelope. Do not include money for transportation. We pay it except on storage "A" batteries. See ads of previous months for other items.

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Genuine Cunningham or Radiotron made by the General Electric Co. Every tube guaranteed new and in original package. We do not sell "bootleg" tubes. Will ship brand in stock unless specified.
R300 UV200 Detector $4.37
R301A UV201A Amplifying 4.50
R11 WD11 1¼ volt. $4.50
R12 WD12 1¼ volt. 4.50
R299 UV199 3 volt. 4.50

QUALITY SOCKETS

For C200, C301A, C12 or WD12 tubes. Signal socket. Tube made of brass, nickeled. Base is bakelite. Panel or base mount. Belden socket. Made of bakelite. Panel or base mount. Great Lakes nickel socket. Panel or base mount. Great Lakes bakelite socket. Base mount only. All sockets have heavy spring contacts.
R1073 Signal Socket $0.65
R1074 Belden Socket ..... .60
R1075 Great Lakes Nickel..... .37
R1076 Great Lakes Bakelite, base mount only ..... .49
WD11 Bakelite Socket ..... .30
WD11 Adapter ..... .43
299 Bakelite Socket ..... .42
299 Adapter ..... .39

GREAT LAKES SUPREME RHEOSTATS AND POTENTIOMETERS

We guarantee these rheostats and potentiometers to be unexcelled. They give perfect satisfaction under constant use. Each turn of the resistance wire is in a groove which makes it impossible to have trouble when the contact slider runs over the resistance wire. Polished tapered knob, base is 2¼ inches and made of heat resisting material. A real value. Priced very low.
R90 G. L. Supreme Rheostats, 6 ohm..$.39
R91 G. L. Supreme Rheostats, 25 ohm .42
R92 G. L. Supreme Rheostats, 40 ohm .45
R94 G. L. Potentiometer, 200 ohm.. .52
R93 G. L. Potentiometer, 400 ohm.. .56

HOWARD RHEOSTATS

R1064 Howard 6 ohm Plain $0.98
R1065 Howard 6 ohm Vernier ... 1.35
R1066 Howard 25 ohm Plain ..... .98
R1056 Howard 25 ohm Vernier ... 1.35
R1069 Howard 40 ohm Plain ..... .98
R1059 Howard 40 ohm Vernier ... 1.35
R1067 Howard 200 ohm Potentiometer 1.35
R1068 Howard 400 ohm Potentiometer 1.85

CUTLER-HAMMER RHEOSTATS

R1061 Cutler-Hammer Vernier $1.35
R1062 Cutler-Hammer Plain .... .90
R1051 Cutler-Hammer 30 ohm.... 1.35
R1052 C.-H. 30 ohm Resistance... .22
R1063 C.-H. 200 ohm Potentiometer 1.35

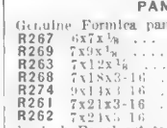
BINDING POSTS

Complete with screw and washer. All brass finished in polished nickel or with black composition top as listed. Order by number. Each Doz.
R110 Large size, all nickeled 7c 75c
R122 Medium size, nickeled, with hole for phone tip or wire.....3c 30c
R112 Medium size, black composition top 4c 35c
R120 *Large size, composition top* 5c 48c

WORKRITE NEUTRODYNE PARTS
Licensed under Hazeltine Pat.

Consists of 3 variable condensers, 3 neutroformers and 2 neutrodon condensers Price for all above parts.....$17.50

CABINETS



Here's a dandy new style cabinet with sliding top. Hand rubbed mahogany. A wonderful value. Panels not included. See panel prices.
R217 6x7x7 .....$2.40
R219 7x9x7 ..... 2.70
R213 7x12x7 ..... 3.40
R228 7x18x7 ..... 3.75
R224 9x14x7 ..... 3.55
R221 7x21x7 ..... 3.95
R222 7x24x7 ..... 4 65

PANELS

Genuine Formica panels, to fit our cabinets.
R267 6x7x⅛ $0.56
R269 7x9x⅛ ..... .90
R263 7x12x⅛ 1.25
R268 7x18x3-16 ..... 2.16
R274 9x14x3-16 ..... 2.60
R261 7x21x3-16 ..... 2.95
R262 7x24x3-16 ..... 3.50
⅛ inch Panel cut to size ..$.01½ sq. in.
3-16 in. Panel cut to size....02 sq. in.

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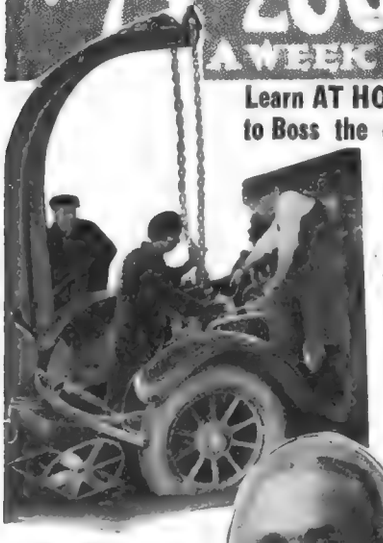

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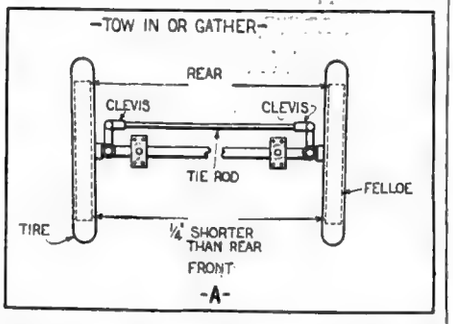
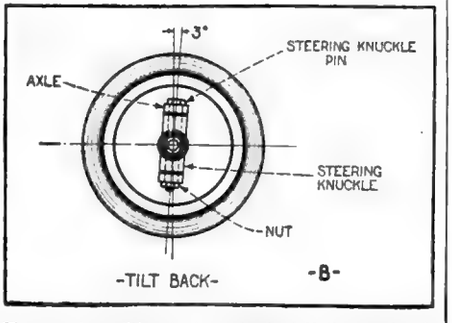
Motor Hints

Steering Gear Adjustments

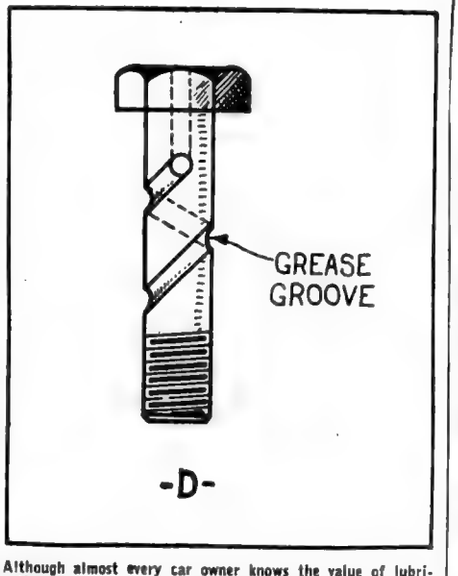
BY TOM C. PLUMRIDGE



There are several mechanical conditions that must be adhered to if the steering of a car is to be kept easy and accurate. The first of these conditions is "tow" or "gather" in the front wheels. This condition is obtained by making the distance between the front of the forward wheels a bit shorter than the rear distance, as illustrated above. This difference should be about one-quarter of an inch. The distance should be measured between the felloes of the wheel.



The second condition to be maintained if the steering is kept easy and accurate is the tilt-back in the front axle. This axle does not set perpendicularly; it is tilted at an angle of about three degrees. Through this arrangement the front wheels are given a caster effect. It has a tendency to pull them back into a straight position after a turn has been executed, which, of course, makes for a greater ease in steering. The steering knuckle is never set vertically, as will be seen in the above illustration. In adjusting this angle it is very important that the angle of tilt be kept pretty close to the standard tilt of three degrees.



Although almost every car owner knows the value of lubrication, many of them forget, in spite of this knowledge, that the steering gear is subjected to wear and tension just as is the motor. Time after time it will be found that the remainder of the car is all well lubricated, while the bearings at th[illegible]ing apparatus are dry as a powder horn. Above [illegible] steering knuckle pin. It is fitted with [illegible] knuckle itself to carry the lubricant. [illegible] allowed to remain for a great le[illegible] will harden. In such a [illegible]efore relubrication.

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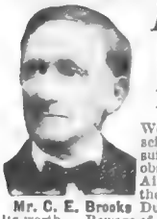

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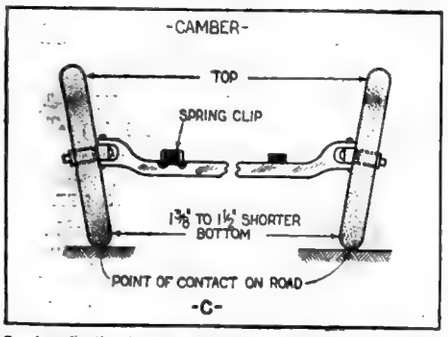
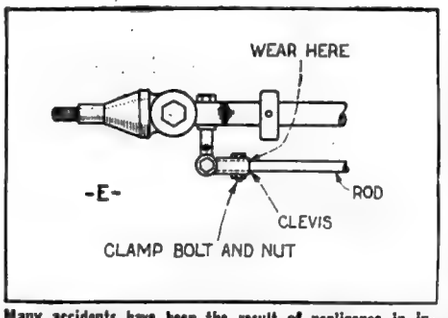
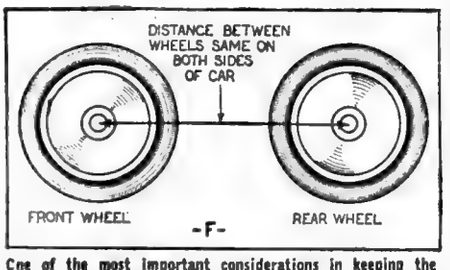


Camber in the front wheels also makes for easier steering and longer wear for the tires. This condition is illustrated in the above illustration. The distance between the top and bottom of the front wheels should differ by about one and one-half inches, as shown. The distance between the bottom of the wheels is shorter. To judge the proper setting of the wheels to fulfill this condition, a line drawn through the center of the steering knuckle should intersect the road at the center point of the tire's contact.



Many accidents have been the result of negligence in inspecting the steering gear at regular intervals. Above is shown the vital parts of the axle, with the knuckle and the connections. The clevis is one of the most common points subjected to wear. A large majority of cars in constant operation will be found to have clevises worn on the rod. They will be loose in many cases, the bolt and nut binding the clevis and the connecting rod will be found to be loose. This nut and bolt should be kept clamped up tightly at all times, since if they are allowed to remain loose, sooner or later, the hole through which they fit will show excessive wear which will result in throwing the front wheels out of alignment.



One of the most important considerations in keeping the wheels in line from the point of view of tire wear and safety, is keeping the rear and front wheels always "tracking." That is, both sets of two wheels should always be kept strictly in line. This condition may be tested by holding a plumb line or other cord across the tires—or better yet, the felloes—of the wheels. The distance between the center lines of the front and rear wheels should be carefully measured and the measurement on both sides carefully checked. The distance separating each set of wheels should be exactly the same.

Above is shown an electrically heated manifold which eliminates the difficult starting problem. A new manifold with the heating element already attached is substituted for the one on the car. The electrical connection is made to the dead side of the starter switch, thus making the heater automatic in operation. It's made for all cars.

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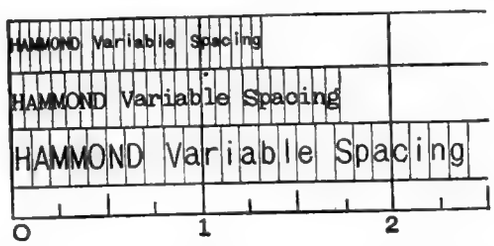

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Service

"I had six honest, serving men;
(They taught me all I knew):
Their names are WHAT and WHY and WHEN,
and HOW and WHERE and WHO." (KIPLING)

WHAT was the Declaration of London? WHAT are consols?
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WHEN and by whom was the great pyramid of Cheops built?
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Answers to Scientific Puzzles

By ERNEST K. CHAPIN

(*Continued from page* 1111)

THE WEIGHT OF THE FALLING STREAM

Apparently the falling stream should increase the weight on the scales. On the other hand the water that at any instant is is in the act of falling is unsupported by the scales and therefore does not contribute any weight to it. Furthermore, if the water is ejected under pressure from the upper tank the reaction of the stream against the body of water above it will still further reduce the effective weight on the scales. It can be shown that these two forces exactly counterbalance the force with which the stream strikes the lower tank.

THE BUOYANCY CYLINDER

The cylinder will not turn at all on account of buoyancy for the reason that the pressure of the water is everywhere perpendicular to the face of the cylinder and hence tends to turn it just as much one way as another.

COMPARING PRESSURES

By pressure is meant the force exerted on unit area. Hence if the area is small on which a given force is applied the pressure may be very large indeed. This is the case with knives, pins, needles, etc. Considering the force as acting on an area equal to the cross-sectional area of the pin we find that a force of 10 lbs. acting on 0.0003 sq. in. will give a pressure of 33,300 lbs. per sq. in. approximately. With the pliers a force of 10 lbs. on the handles will yield a force of 100 lbs. on the object between the jaws. If the area against which this force is applied is 0.03 sq. in. the pressure will be 3,333 lbs. per sq. in. or about one-tenth as much as was applied by the pin.

BURNS FROM STEAM AND HOT WATER

Live steam produces a worse burn than scalding water even though both may be at the same temperature because it contains more heat energy than the same quantity of boiling water. To be more exact a gram of live steam contains about 540 calories more of heat than a gram of boiling water. Hence if a gram of steam should condense on a person's hand it would give up 540 calories of heat and still be as hot as boiling water.

THE PIVOTED FRAME

The frame is so pivoted that it cannot be distorted from its rectangular shape by the addition of weights on the projecting arms. Of course the members are bound to "give" somewhat under stress but aside from this the frame would remain as it is because any tendency of the T-shaped members to turn about either A or B would merely crowd pivots C and D together. But, since the latter are stationary it is evident that the frame is fixed in position.

FORMATION OF ICE

Contrary to the characteristics of most substances water does not continue to contract indefinitely as it is cooled. When water reaches 4 degrees Centigrade it expands on further cooling. Hence as a lake is being cooled by the air the coldest water will sink to the bottom of the lake until it is 4 degrees C. But from then on as the water cools the coldest water will remain at the surface and so it freezes first.

CAN THE BOY RAISE HIMSELF?

It is theoretically possible for the boy to hoist himself by this method though in practice it would be a little difficult to maintain a sufficient pull on the rope and still keep balanced. If the boy, the stirrup, the pulley and all weigh a hundred pounds, the rope A

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will have to stand a tension of a hundred pounds which will, in turn, have to be maintained by the boy on rope A. This force would keep him balanced. To hoist himself he would have to exert enough force in addition to overcome friction.

THE SKIDDING AUTO

Unless a car is heavily loaded there is more weight on the front wheels than on the back ones. This is due, of course, to the weight of the motor. The front wheels then act as a pivot about which the car turns on account of the energy of its motion.

THE CHRISTMAS TREE LIGHTS

If one or more lights in series are shorted by a conductor the full applied voltage is impressed across the remaining lamps that are still in the circuit and each lamp is subjected to a greater votlage. Thus if five lamps were shorted and three left in the circuit each lamp would be subjected to 110/3 or 36.7 volts which would be sufficient to burn them out if they were designed to stand no more than 30 volts. In the case cited it is evident that four lamps would not be burned out since the voltage across each would be 110/4 or 27.8 volts. The shorts that would leave three lamps in the circuit are BE, CF, and DG.

THE SAND AND WATER LEVELS

Unless the particles of sand were rather large and settled rapidly it is not likely that any change in the levels would be noticed when the valve connecting the tanks were opened. This is because the liquid pressure is transmitted independently of any solid matter held in suspension by it. Of course, as a particle sinks it produces a small current upward past it, which would react against the portion of the liquid below it and thus tend to force some of it into the other jar, but in general the effect would be small.

THE BUOYANT FORCE ON THE CUBE

The buoyant force on a submerged object is due to the difference in pressure of the liquid on the upper and on the lower surfaces of the object. If the pressure on the under side of the object can be removed by pressing the object so firmly and squarely against the bottom of the container that no liquid can get in between, it is evident that all of the buoyant force must disappear. In practice it is usually found difficult to prevent the liquid from getting under and raising the object but if the surfaces in contact are well polished it is possible to make the object remain submerged even when it is light enough to float.

METALLIC AND PORCELAIN DOORKNOBS

Fingers stick to metallic objects in very cold weather because metals conduct the heat so readily from the fingers that they are frosted to them. Porcelain objects, on the other hand, may be at the same temperature but they do not conduct the heat readily enough to produce the effect.

Chassis Lubricator

Above is shown a new grease gun for lubricating automobile chassis. It follows the regular grease gun principles except that the nozzle fits onto a conical cup which is connected to the bearing to be lubricated. The grease is put in the gun by removing the cap and the plunger unit in the regular way. A pressure of nearly 5,000 pounds per square inch is available with the gun.

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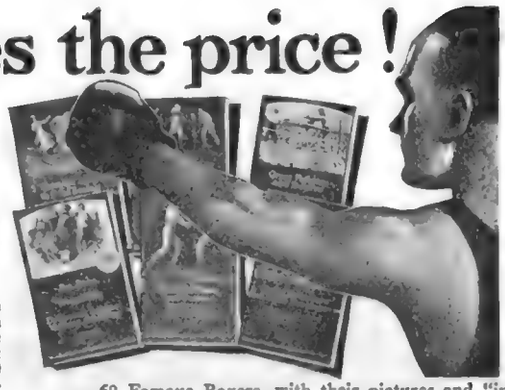

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Pays For Itself ~ Earns Big Profit

The Heavens in March

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1112)

ern Cross, the Milky Way is particularly brilliant and intricate in form. In its most brilliant portions it is crossed by numerous dark lanes and bars and filled with "Coal Sacks," apparently dark holes, but in reality dark nebulae. Reaching its greatest width in Argo, the Milky Way comes into view in our latitude this month due south. Extending in a northwesterly direction from Argo it grazes Canis Major on the east, passes through the inconspicuous constellation of Monoceros and fills most of the space between Gemini and Orion. From here it continues in a northerly direction past the horns of Taurus, into Auriga, through Perseus to its most northerly point in Cassiopeia and Cepheus and from there tumbles down to the northern horizon. Later in the spring and early in the summer it will lie too close to the horizon to be seen to advantage.

AT THE MERIDIAN

Nearest to the meridian this month we find the two inconspicuous constellations of Camelopardus and Lynx north of the Zenith, while Gemini and Cancer lie to the south and southeast of it. The head of Draco has now taken the place of the Big Dipper at the northern horizon. At the southern horizon we have the northern portion of Argo Navis. Castor and Pollux, the two twin stars in Gemini, and Procyon, the first magnitude star in Canis Minor, the Lesser Dog.

Cancer, The Crab, which lies just to the southeast of Gemini, is the most inconspicuous of all the zodiacal constellations. It contains, however, one object of interest

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known as Praesepe, or The Beehive, also called occasionally "The Manager." This is, to the unaided eye, a nebulous cloud of light. An opera glass will resolve it into a coarse cluster of seventh and eighth magnitude stars. The two faint stars that lie on either side of it are known as "Aselli" or "The Donkeys."

Some two thousand years ago the sun was in Cancer when farthest north at the beginning of the summer but now, owing to the gradual westward shifting of the equinoxes, known as the "Procession of the Equinoxes," the sun is in Gemini instead of Cancer at the beginning of summer. We can see, by referring to the chart, that the two circles, the equator and the ecliptic, are most widely separated at the center of the chart between Gemini and Monoceros. The circle marked equator indicates the intersection of the plane of the earth's equator with the heavens. If we were at the equator we would see all the stars on this circle pass directly through the zenith. The circle marked ecliptic, on the other hand, marks the path of the sun through the heavens in the course of a year. As the chart shows the point at which the sun is farthest from the equator lies in Gemini and this point is reached by the sun about June 21st each year.

THE PLANETS

The position of Venus on the fifteenth of March at eight o'clock and on the thirty-first of March at seven o'clock is indicated on the chart. At nine o'clock on the first of March it is below the western horizon in Pisces setting during the month between eight and nine o'clock. Venus is now a magnificent object in the northwest in the early evening. Its angular distance from the sun is increasing and will continue to do so until the latter part of April. It is now setting between two and three hours after the sun. It is gradually approaching the earth and its brightness will continue to increase until it attains its greatest brilliancy toward the end of May.

Saturn is now visible late in the evening in Virgo but will not be seen at the time for which our chart is made out until later in the spring. Mars and Jupiter are visible in the east before sunrise. During the month Mars will move eastward from Scorpio into Sagittarius. Its distance from the earth on March 1st will be 139,000,000 miles and on March 31st 114,000,000 miles. Its distance at close opposition of this year in August will be less than 35,000,000 miles, almost the closest possible approach. Jupiter is now in Scorpio. On March 9th it will rise at mid-night and will be on the meridian at sunrise.

Timer Roller

No more will the luckless car owner have to dirty his hands with grease and his soul with a midnight stream of expletives and blasphemies on account of a recalcitrant timer roller deciding that the life of a rolling stone is an ill one, and having reached such a philosophy of existence, refusing further to perform its regular function as an integral part of the luckless car owner's automobile. In the illustration above is shown a new roller, made of tool steel with fibre ends which is to take the place of the older garden variety. The tool steel construction guarantees long wear and the fibre ends assure perfectly quiet and smooth operation. The fibre end also prevents the roller dragging on the arm and thereby keeping it in its true course, preventing excessive wear on the race. The manufacturers claim that after several thousands of miles of operation this roller presents a smooth, glassy appearance, free from wear and pits.

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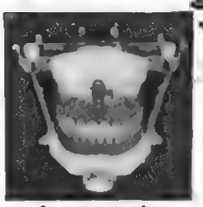

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Dr. Hackensaw's Secrets

BY CLEMENT FEZANDIÉ

(*Continued from page* 1093)

old Doc. eats out of my hand. Sure I'll introduce you. I'm invited to dinner there to-morrow, and I'll take you along as an escort. I'll be glad to have you, because the Doc has invited a rich young fellow, and I want you to keep the Doc busy and give me a chance to get the young fellow to myself."

.. ..

II

"Glad to meet you, Mr. Fitzmaurice," said Doctor Hackensaw. "Any friend of Miss Pep's is a friend of mine. I am at work just now on some experiments in grafting—the grafting of animals, you understand, not of plants. The subject has always had an extreme fascination for me. The subject of grafting is closely related to that of the 'Regeneration of Lost Parts.' In fact, it was the study of the latter that first led me to take up grafting in real earnest."

"I'm afraid I don't exactly understand what you mean by the 'Regeneration of Lost Parts,'" said Percy diffidently.

"I mean simply this, that many plants and most of the lower animals possess the power of growing a new part to replace a part that has been cut off. For example, a florist will cut off a slip from a geranium and plant it, an entire new geranium plant will grow from the slip. Sometimes it is sufficient to plant a small bit of geranium leaf. This sends forth roots and grows into a complete plant. Theoretically a single cell of the plant ought to be enough for a start.

"Now, in like manner, the lower animals also possess the power of growing new parts. When a lobster breaks off one of his claws, a new claw immediately starts to grow in its place. When a lizard is caught by a snake it escapes by breaking off its tail. It then grows a new tail in order to be ready for the next snake. The salamander can likewise grow a new leg, and certain low forms of animal life can even grow a new eye if they lose the old one. In warm-blooded animals and in man, this power of replacing a lost organ is very limited. No bird or mammal has the power of replacing even the end joint of a toe if it is lost. Their power of regeneration is confined to the reuniting of a broken bone or the replacement of the flesh in a wound that is not too deep.

"Evidently this regeneration of parts is merely a question of growth. When you cut off a lizard's tail, why does not a new leg grow on the spot instead of a new tail? And why does it grow to the same size as the old one? These are problems that are not yet solved. Scientists say that when the organ has grown to the proper size and shape, further growth is checked by 'inhibition.'"

"Inhibition? What's that?"

"The body, like any other organization has headquarters from which orders are sent out for the purpose of co-ordinating all the parts and making each do its proper share of the work at the proper time. When, for instance, the stomach has digested a meal, the flow of digestive juices is automatically stopped or *inhibited*. Now it is believed, at least by certain scientists, that in like manner, when the lizard's new tail has grown to the proper size, the growth is automatically checked in much the same way.

RELATION TO MAN

"To me, there seems absolutely no reason why a man should not be able to grow a new arm or leg when the old one is cut off.

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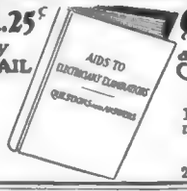

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Why should he be inferior in this respect to the lobster and the salamander? The power of growth and multiplication of a cell is practically unlimited. Talk of immortality! As a matter of fact, every animal or plant alive today is but the continuous outgrowth from the primitive cell that formed the amoeba from which every living being has sprung. Every man's life has really been continuous for millions of years!"

"Were you successful in your experiments, doctor?"

"Unfortunately, no. All my attempts to cause a new limb to grow failed. I followed in the footsteps of Doctor Alexis Carrel. You have probably heard of his experiments. He succeeded in preparing a solution in which an amputated arm or leg may be kept alive for months. Other tissues, when placed in the solution, will not only live but grow. I became convinced that here was the key I was seeking, and that, if I could only hit on the correct treatment, I could place a guinea-pig with an amputated leg in the solution and cause new leg tissue to grow until the damage was completely repaired. So far I have met with no success. I find the bones, especially, a great stumbling block, for the growth of bone is not easily co-ordinated with the growth of tissue. Some day I hope to succeed. There is no reason why new cartilaginous bone and tissue should not be formed at the same speed, as they are in the foetus or unborn animal. But my results were so unsatisfactory that I had to turn my attention to a more promising field—namely, grafting.

"Every gardener knows how to graft one plant on another. The grafting of a part of one animal on another animal has also been successfully accomplished. In fact, the art was successfully practiced many years ago. The so-called 'rhinoceros rat' is a rat with the end of the tail of another rat grafted on its head and growing there. In the old time German student duels, when a man's nose happened to be sliced off, a new nose was grown by making an incision in the man's arm, placing the nose in this incision and tying the arm in place until nose and arm had united, when a new nose was carved out of the tissue of the arm. The modern method is to cut a flap of skin from the forehead and bend it down and graft it on the mutilated stump of the nose. Of recent years far more wonderful results have been obtained. Doctor Alexis Carrel, for example, has succeeded in grafting the leg of one dog in place of the amputated leg of another. He even succeeded in the much more difficult task of transplanting the kidneys of one animal to another. His success was largely due to his having found the means of making an almost perfect union of the veins and arteries of the one individual with those of the other. He, however, failed completely when he tried to transplant the kidneys of a dog to a cat, or those of a cat to a dog.

"An important fact is that the younger the animal, the more easily is the graft made. In the pre-natal or embryonic stage, practically any amount of grafting can be performed. Geoffroy de St. Hilaire once wrote a book on monstrosities. If you want the wildest kind of a nightmare you need only look at the pictures of the human monstrosities which have resulted from the natural union of two unborn babies in the womb. Everyone has heard of the Siamese twins which were thus united by a ligament. Calves with two heads and chickens with four legs are not uncommon. Evidently two egg-cells, in developing, have thus grown together to form one individual.

SOME RESULTS

"But enough of this talk, Mr. Fitzmaurice. If you will accompany me, I will show you some of my practical results."

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Doctor Hackensaw led the way and Percy obediently followed. Pen after pen of monstrosities were exhibited, freaks such as a circus would have given a fortune to possess. Among other things was an animal with the horns of a cow, the head of a horse, the body of an ostrich, and the legs and arms of a monkey, while the tail was a snake's body without the head. To enumerate the creatures would be impossible. Large and small animals were there, vertebrates and invertebrates. It was a collection such as would make a man think he was back in the old days when there was no prohibition. To see a dog's body, with three living heads of cats grafted on it, gave Percy quite a shock, and yet it was only one of the least of the curiosities exhibited.

"Are you able to graft a warm-blooded animal with a cold-blooded one?" asked Percy.

"Yes," replied the doctor, "but in such cases I have to use an intermediate graft. For instance I couldn't graft a dog and a cod-fish together. But by grafting the dog on a marsupial—that is to say on an opossum or a kangaroo, and the opossum on a reptile, I can then graft the reptile on the fish. Of course, each graft must be allowed to unite properly before the new one is made—I have even succeeded in grafting *animals* on *plants* by using as intermediate grafts, such low forms of invertebrates as the sponges."

"Doctor," asked Percy, coming at last to the point which was uppermost in his mind, "haven't you any human beings grafted in this manner?"

REBUFFED

Doctor Hackensaw frowned. "I don't perform my experiments with humans," he answered shortly. "Only in cases of absolute necessity would I resort to such a step. I'm sorry I haven't time to show you any more to-day, but I must get to work."

Rebuffed in this direction, Percy nevertheless did not give up hope. He determined to climb over the wall again and try to get another glimpse of the mermaid. But though he came every afternoon for a week, he neither heard her song nor did he see her in the lake. His first appearance had evidently frightened her.

But Percy was persistent. "Perhaps I'd better try at night-time," thought he. "I may have better luck then. So, stepping into his flivver, Percy started off for the doctor's villa. Not wishing to run the risk of frightening the girl by the sound of his machine, Percy stopped the car some distance away from the spot where he had before clambered over the stone wall. And then, to his surprise, he heard a voice cry out:

"I've got her, Bill! Crank up! Quick!" This was followed by a girl's piercing shriek, muffled at once by a heavy hand over her mouth.

"Hurry up there, Bill! Get away from here before any one comes!"

The auto began chugging, and then came thundering toward Percy at a terrific rate.

What could Percy do? He pressed his starter and had a wild impulse to place his car in the middle of the road, in order to block the villains. But this might mean instant death to the girl as well as to himself. Then an inspiration came to him, and seizing his spot-light, he turned the glare full in the eyes of the approaching chauffeur. The result was instantaneous. The driver, blinded, at once slowed up speed, but, unable to see the road, had not gone fifty feet when the machine dashed out of the roadway and went crashing against the stone wall. The windshield shivered into fragments, and the chauffeur, thrown against his steering wheel, was lucky to escape with no damage except

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a couple of broken ribs. As for the other villain, Percy was upon him in an instant and with one blow knocked him senseless. Then he turned to the released girl in the auto, who was screaming at the top of her lungs. The young man lost no time. He grabbed her in his arms, and then to his surprise, he realized that this was no ordinary girl—it was the mermaid whom he had seen in the pond.

Wild with delight, Percy carried her to his own car and then started off at full speed for the entrance to Doctor Hackensaw's grounds.

AN EXPLANATION

Doctor Hackensaw was reading in his library, but at the sound of the violent honking of the auto, he came out to see what was the matter. Percy, carrying the girl in his arms, unceremoniously entered the house, and depositing his burden on a sofa, explained matters in a few words.

Doctor Hackensaw thanked him warmly, and then proceeded to explain matters in his turn.

"You see, Percy," said he, "when you asked me last week, whether I had ever made any human grafts, I refused to answer you. That was because I did not wish the existence of this young lady known. Let me introduce you. This is Miss Olla Podrida, one of the acrobats of Mr. Lyon's circus. Some months ago, Olla, while performing a high dive at the circus, unfortunately slipped and had a bad fall, crushing both her legs. I happened to be in the audience, and I saw at once that there was no hope in saving either of her limbs. On the other hand, if I cut them off, her entire future would be ruined. Think of what life would be to a young girl with both legs cut off close to her body!

"Then I happened to think of the trained seals that had just been performing. Here was a chance to perform a human graft, for the seal is a warm-blooded animal. Accordingly I was careful to amputate the girl's legs in such a fashion that it was easy to graft to them the tail of one of the seals. I was greatly pleased to find that the graft succeeded admirably. And this explains how it is that Olla is now a mermaid instead of an ordinary girl. She was always very fond of the water, and enjoys nothing so much as a swim in the lake. Unfortunately she has a beautiful voice, and she will insist on singing. I don't know who these villains can be who tried to kidnap her. I presume they heard her singing and climbed over the fence. When they saw Olla, they probably thought they could sell her to some circus for a good round sum. I shall try to have them arrested, so they will not be a menace in future. My servants are attending to that now."

"And is Miss Olla to remain a mermaid all her life?" asked Percy, glancing at the young girl, who had covered herself with a shawl, and who now glanced shyly back at him.

NEW LEGS!

"No, thank Heaven! I was just keeping her in that form until her two new legs are ready."

"Her two new legs?" echoed Percy, in surprise.

"Yes, I am growing two new legs to fit her. For many years I have been working on this problem, and I knew that some day I should need something of the sort. So from fertilized ova I have grown a varied assortment of pairs of legs and arms of different sizes, to be used when occasion requires. At the time of the accident I had none on hand that were quite ready. There is, however, a suitable pair of legs that will be ready next week. I shall then cut off her

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seal's tail and graft legs in its stead. In a few months she will be able to run about and even dance as well as ever, in fact better, for I warrant the new legs will be an improvement on the old ones.

"And now, Percy, as the operation will require Miss Olla to be confined to her room for some weeks to come, and as the time will hang heavy on her hands, I hope you will call often to cheer her up."

"I certainly will!" cried the young man; and the young lady rewarded him with a smile, as she renewed her thanks to him for what he had done for her.

.. ..

The grafting of the new legs was a success from the very start, but it was fully three months before the young lady regained complete control of her limbs. When she did, she did not return to the circus, however, for by that time Percy had persuaded her to change her name from Olla Podrida to Mrs. Percy Fitzmaurice.

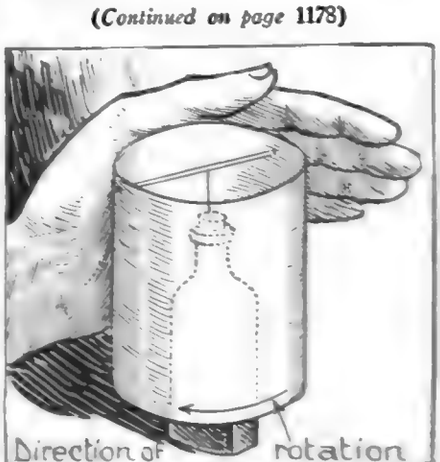
Awards in $50.00 Psychic Motor Prize Contest

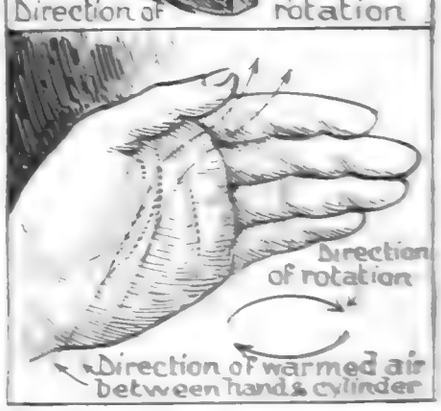
(*Continued from page* 1115)

Motor and the hand to rise and ascend, and it is reflected by the base of the thumb, toward the finger-tips and upward. The motion of the air produces a twisting effect upon the cylinder, due to the air's friction with the surface of the light, delicately balanced and almost frictionlessly suspended paper cylinder, constituting all the essential elements of the Psychic Motor.

This causes the motor to revolve, when the opposite hand is held, as in the previous case, near the paper cylinder, in the opposite direction as the current flow of air reverses.

(*Continued on page* 1178)





The psychic motor consists of a piece of writing paper about 2½" wide glued so as to form a cylinder approximately 2" in diameter. Holes are made diagonally opposite in the cylinder and a straw passed through them. A needle is passed through the center of the straw and the whole device inverted on top of a pass-topped bottle. The winner of the fourth prize explains the cause for rotation and furnishes the diagrams given above.

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The Man on the Meteor

By RAY CUMMINGS

(*Continued from page* 1091)

like the stalk of your banana tree. The leaves were intricate and beautifully shaped; and there were millions of tiny air-pods growing everywhere.

When I first saw the city of Rax, I remember marvelling at the ingenuity that could build it. But soon I marveled at the greater ingenuity that could maintain its interior form. The main stalks changed little from year to year. But a constant pruning, altering, uprooting and replanting was necessary throughout every detail. The very walls of a man's house were of varying form. Yet, since each man was responsible for his own, it was easily done.

Above the city, the great branches of the main stalks spread out—green-brown wavering things, a lace-work of great ferns with hundreds of pods twice as big as a man's body—the air-bladders which sustained the entire city.

THE ETERNAL CALM

I have said the water was calm. Not a ripple down here save those made by the animate things themselves. Nature was passive. The half-twilight never altered; the temperature remained always the same; no storms, not a sound of the world disturbed its peace and calm.

Thus stood the city of Rax—tenuous wavering gently throughout its every fibre. A city which, with one of your Earth-swords, I could have cut loose from its moorings and slashed to destruction. And you shall hear how one day I did something like that to a similar city. Not destroyed it indeed, merely—but first I must tell you what happened before the coming of Boy—our boy, Nona's and mine—our little son.

II

We lived first in the home of Caan—the leader of the Marinoid party which captured us. He was in charge of gathering the shell-food from the water-bottom in the open spaces beyond the city.

I must sketch all this briefly—there is so much to tell you. We were at first, curiosities to the Marinoids. But we proved our friendliness; and when we learned their language they made us welcome among them.

Our history—what little we had to tell them of the outer world of air, the meteor, the heavens, the great Universe of which we are all so infinitesimal a part—none of this could they comprehend. But—and you of Earth mark me well—these Marinoids did not scoff. They were not unduly credulous either. Their ruler sent for me; and with a thousand ingenious questions sought to test the truth of my words.

I am sure now that it was this knowledge I held of things they had never dreamed of, which raised me to a position of importance among the Marinoids. That, and my physical prowess, which very shortly I was forced to demonstrate.

At all events, I did become a figure of importance in Rax. The ruler—an hereditary monarch whom I shall call King for simplicity — consulted with me frequently after a few months.

When Boy was born they gave us our own home. Caan had been very good to us; we counted him our best friend. He swam about the city with Nona and me helping us to select from among the vacant dwellings.

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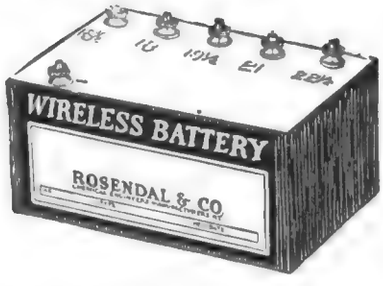

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Can you picture us upon such a journey? The horizontal streets were like square tunnels twenty feet broad and equally as high—top and bottom a tangle of woven, green-brown vegetation, carefully pruned; sides formed by the rows of houses. There were windows and doors to the houses, with removable screens of vegetation.

The streets were artificially lighted. In the open water outside the city there was enough light inherent to the water itself to give a sort of twilight. But within the city, shut in by all this vegetation, it would have been too dark for comfort. At intervals along the streets a transverse strand of vine was stretched. From it hung a huge pod—half as big as a man perhaps. The pod was a vegetable air bladder, of a variety whose walls were exceedingly thin and translucent.

From these pods, which hung like lamps, a greenish-silver glow emanated. It spread downward in a ray of illumination through the water of the street; it cast queer, blurred, monstrous shadows of the Marinoids swimming past it.

You will be interested to know what the light was. Small, self-luminous organisms were gathered from the open water and placed—hundreds of them—in the translucent pods. Similar organisms to these form the familiar "phosphoresence" of the tropical waters of your Earth. But these were much larger—more the size of your glow-worms.

MARINOIDS AT HOME

We swam slowly along. A few Marinoids were in the streets, passing us as they went to their occupations. From a window, or the bottom of a doorway, a naked child would peer at us with big curious eyes. In a horizontal street of more pretentious houses, where the tunnel deepened to two stories, a woman sat in the corner of a little balcony, nursing her infant. Beside her, two older children played a game with shining opalescent shells.

We turned upward into a vertical street. You would call it a huge elevator shaft. Its lights were fastened to the sides of buildings. Here the houses were one on top of the other— a single low story only, and very long horizontally. Nona did not like them; one was vacant here and Caan suggested it but she refused it decisively. I had no opinion to offer; they all looked all right to me.

We swam upward and soon reached the central cube of open space. Here was the ruler's palace. Open water surrounded it on all four sides, and on top. The main stalks of the building grew above it with graceful hovering fronds of green—fronds whose smallest pods were luminous like a hundred tiny Chinese lanterns—under which, on the roof of the building, was a garden. There were small plants growing there, gleaming white shells laid out in designs, a bed of black ooze with brilliant red things like flowers growing in it. A row of small illuminated pods formed a parapet to the roof-top.

The main building was not as large as the term "palace" sounds—it was not over fifty feet in its greatest dimension. It had both vertical and horizontal balconies, and a broad horizontal doorway near the top—a doorway built of shimmering iridescent shells plastered together with mud and a gluey substance which was made from one of the Marinoid plants. And on a tiny platform by the doorway lay the shell sleigh with its marine animal and its driver in waiting—the sleigh in which I had first seen the King.

It was to us a magnificent dwelling, this palace. Nona and I floated before it, gazing with awe. But my heart sank, for I knew that now once Nona had seen it, we should have much more difficulty in selecting our own humble little home.

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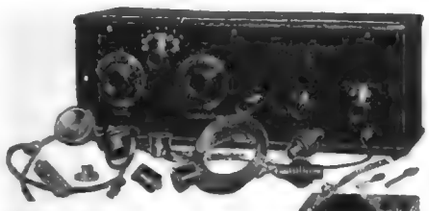

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AGENTS

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THE MIDWEST RADIO COMPANY
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It was indeed, almost the time of sleep before Nona made her choice. She selected a two-story house, at the intersection of a horizontal with a vertical street. It had one room upstairs, and two downstairs—small rooms, you would call them, no more than fifteen feet cube.

But the house had a little horizontal balcony upstairs. On it Nona could lie and watch the people passing. And Caan told us that these streets were on the route the King habitually used when leaving the city with his equipage. I think it was the balcony that decided Nona. For myself, I was pleased because we were only a very short distance from the home of Caan.

Our room of sleep had bunks built into the wall—bunks which were soft with a springy growing mass of mattress—a grey-white growth which *you* would call a sponge. There was a large ornamental shell standing like a table in the center of the room; and a window giving onto the balcony and the street. The window had a leafy, swinging blind for privacy.

VENTILATION

For ventilation we left the window open. Ventilation, you say! Ventilation in a city of water! Most assuredly. Your most humble fish will die without fresh water. We were using the air held in solution by the water; and fresh water with new air was constantly necessary.

Once, after each time of sleep, the whole city was "ventilated." Swimming animals—sleek shining things of brown, with slimy bodies like wet seals—pulled a sort of shield rapidly back and forth through the streets. The shield was large; it almost filled the street. Its movement stirred the water; pulled the water by suction into the city from outside.

I was describing our house, but there is so much to tell you I must be briefer. Downstairs we had circular shells to recline in and a place to store and prepare our food. And every room was lighted with a pod which had a green-moss shade that could envelope it when darkness was desired.

Nona was delighted with the house and immediately began planning a hundred ways to improve it. The place was in good repair, but there was much pruning and retraining of the vegetation to be done. And then, when we had slept in the house but once, and were both busily engaged with our own affairs, Og came to see us. He came to see Nona, I should say—for certainly *I* never liked him. His coming was the immediate cause of my being forced to display my physical strength—to which occasion I have already alluded.

I fought Og twice—the first time in a pretentious hand-to-hand combat before the King's palace, which attracted the attention of the entire city. It was a queer combat—unfortunate for me. I shall tell you about it at once.

III

Og stood in our little doorway, talking to Nona. He was a young man about my own age. I have since learned he was not full-blooded Marinoid—but that can come later. He was somewhat taller than Nona, but shorter than myself. His legs, with their connecting membrane, were bare to slightly above the knee. From there to his shoulders, he was dressed in the characteristic Marinoid fashion—a single-piece garment of green woven grass. On his bulging chest he wore an ornament—a flat, circular affair of many tiny shells linked together. His four, tentacle-like arms waved before him. The hair on his head was thick and matted, but short. With one of his pincers he would occasionally brush it—a gesture evidently intended to impress Nona with his grace.

Og's face—with features not much different from my own except that his mouth

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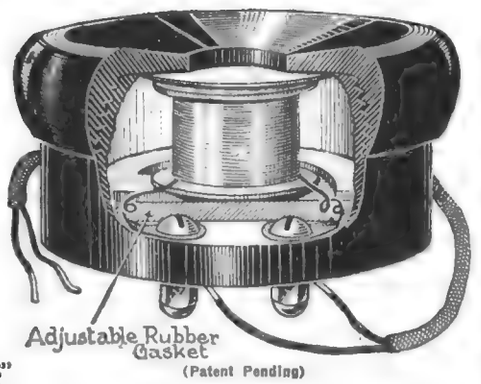

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was larger and his eyes slightly protruding—was nevertheless most unpleasant. His chin was weak, his expression egotistical; and more than that, I never liked the way he looked at Nona.

A queer sort of being—this Marinoid—for me to be jealous of! If you are thinking that, you are wholly wrong. We were living in a Marinoid world, and in all that world only Nona and I were queer-looking! *It was we who were abnormal, not they!*

Nona, with her flowing hair and her short grey-green Marinoid jacket, was to me the most beautiful creature in the world. But, as Caan pointed out, our eyes—Nona's and mine—were set too deep in our head to be of real use in seeing sidewise. Our mouths were too small to admit the water comfortably, and our chests too small and immobile to handle it properly. Two arms, which could bend in only one direction, were surely not so advantageous as the four Marinoid arms; and our legs, without the connecting membrane, would keep us always very indifferent swimmers. This was before I demonstrated my muscular strength; Caan changed his opinion a little after that.

THE INSULT

I have wandered from Og. Nona unwittingly attracted him, in spite of her physical handicaps. I know why now. He was a half-breed; the blood in his veins which was not Marinoid barred him from finding a mate among the Marinoid women. And when Nona came he wanted her.

I did not know this at the time, but I sensed it. And Nona too was afraid of Og, though she had not shown it outwardly.

I was in the other room this time when Og came to our new home. He stood there talking to Nona; and suddenly I heard her scream. I launched myself in a dive through the inner doorway. They were up near the ceiling and Nona was struggling with him. He was laughing; he dropped her, and came swimming down to face me, still grinning insolently.

"She is tempting" he said. "She has learned the ways of the Marinoid women very quickly."

I swam at him, but he avoided me; and before I could seize him, Caan appeared in my doorway and stopped me.

Nona was crying. Caan would let me do nothing. Physical altercations were a dire offence in Rax. I could report Og for trial and punishment, but I could not personally attack him.

In his insolent confidence, however, Og did the one thing I would have wanted. He swam at me and struck me lightly in the face with the side of his left-front arm. It was not so different from one of your old customs here on Earth. He had challenged me to public combat. A duel? Call it that, if you wish.

Caan made all the arrangements. We were to fight after the next time of sleep, in the open cube before the King's palace, with the King, Queen and young Prince on the palace roof to judge us.

Nona was frightened; she cried all that day. At Caan's suggestion we slept that next time in his home, where his wife (I use the term wife, although it is inapplicable) could care for Nona.

The combat was to be without artificial weapons—and in spite of Nona's feminine fear—I could not take it seriously. I was only twenty, you will remember, and youth is absurdly confident in itself.

Caan, however, was very grave. I did not know it at the time, but the combat was intended to be to the death. Og understood it so—and the whole city was stirred by it. As for the King, it would be an interesting sport for him as spectator; a thousand times of sleep had passed since such a sight had been offered.

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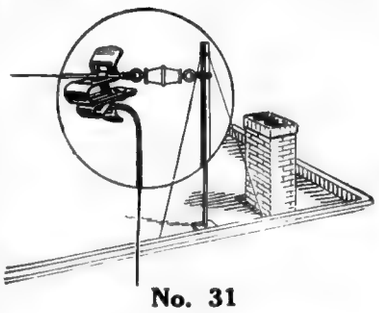

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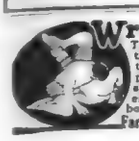

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Caan was very kindly to me that evening, solicitous and perturbed. Once he started to question me about my methods of fighting. Youth is so foolish! I laughed at him.

"I shall twist him in my hands before he can touch me," I said boastfully. "We will not talk of it now, my friend Caan. It frightens my Nona."

At once he subsided. He had indeed something important to tell me. But my words chanced to make him think I knew it. The Marinoid is by nature reticent; he will force nothing upon you—offer no advice that you do not solicit. I was as it happened entirely ignorant of this thing he feared; had I not been I should have looked forward to the combat with alarm and probably terror.

Nona would not go to the scene. But Caan went to represent me, and he lay on the palace roof beside the King.

THE SCENE OF THE FIGHT

The cube of water was a brilliant, gay arena. Illuminated air bladders were hanging from the palace balconies and from the foliage above its roof-garden. Everywhere about the cube, top, bottom and all four sides, these lanterns were banked in rows, so that the open water in which we were to fight was a bright, greenish glare of light.

On the roof-top there were perhaps ten Marinoids in addition to the Royal Family. They were reclining behind the row of lamps; and these lamps were shaded like the footlights of one of your theatres.

Across the cube, facing the palace, were a few balconied houses of the more important inhabitants of the city. Their lights, too, were shaded to throw the beams outward toward the open water. These balconies were all crowded with Marinoid men and women.

At every street entrance to the cube other Marinoids were crowded; a hundred or more of them lay prone on the lower surface, their gaze directed upward. And above, a swarm of others clung to the roof of the arena, or hovered in the foliage, staring downward.

The King's sleigh was gone from its platform; a group of his guards stood there instead. Occasionally one would swim out to warn back a trespasser.

When Caan and I arrived, the figure of Og, nude save for a loin-cloth, was hovering alone near the center of the open water; his legs were moving very slowly, his four arms waving as he sustained himself. Every eye in the crowd was upon him. His face bore a confident, leering smile—the challenger waiting for his opponent.

Shouts arose as Caan and I pushed forward through the crowd. Caan took my outer garment, and with a grave word of encouragement, left me. My gaze followed him as he swam upward to join the King's party.

A hush fell upon the crowd. The water now was soundless; then suddenly Og called to me—a sneering shout of defiance. My youthful blood flowed hot with anger. I was not afraid; I was sorry Nona was not here to see me fight.

Slowly I mounted upward through the empty water to meet Og. And then the Queen did a curious thing. Her soft but commanding voice rang out over the stillness; she ordered me up to the roof-top.

I obeyed, hovering respectfully before her.

"I hope that you will win," she said softly, yet loud enough so that all might hear. "You are badly equipped to fight—but you are in the right."

There was some applause, for Og was not popular in Rax; but she silenced it.

"Go—do your best." She dismissed me with a gesture.

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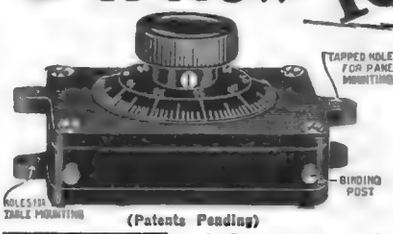

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As I was turning away, my heart swelling with pride at the incident, the young Prince—he was about my own age, and had already shown some liking for me—called out softly but vehemently:

"Nemo, do not let him touch your head and feet at the same time."

"No," I said, "and I thank you both."

I swam slowly back to meet Og. I had no idea what the Prince meant; but I followed his warning as well as I could, until in the heat of the fight, as you shall see, I forgot it.

Og was waiting, facing me alertly. His arms and legs had ceased waving; his body was tense; he was sinking slowly downward. I followed him down with no more than ten feet separating us. I wondered when he would come at me. I would wait; then grip him around his chest and crush him with my superior strength.

The silence in that bright, glaring water was oppressive; we were sinking nearly to the bottom of the arena. Without warning, I doubled my body and dove forward—rushing at Og with all the strength I could put into my swimming strokes.

IV

I was a good swimmer; there are none like me among the humans of your Earth. But I soon found I was not the equal of Og. He eluded my first rush. With his arms close against his sides, his body slipped between my outstretched hands. He mounted upward—a pink streak through the glaring water.

I was after him. Up in the foliage, almost directly over the King, he hovered, waiting for me. The contemptuous smile on his face maddened me. As I came up, he turned sidewise into another dive, but I gripped his ankle as it went past me.

The crowd was shouting as we floundered, churning the water. I was trying to turn and clutch Og around the body. But he twisted away. I knew, if I could once get him in my grip, I could crush him. But he seemed to know it also.

I still held his ankle, and he did not try to kick himself loose. He seemed to be manoeuvering for something. He was swimming forcibly downward now, using his arms but leaving his legs limp. It drew our bodies through the water in a single straight line, like one boat towing another. Then Og turned into a sharp circle. I still clung to him, and his body, bent like a bow, went over mine. The movement brought his head near my feet. One of his arms swept down, made a clutch for my ankle, but missed.

I heard the shout of mingled horror and relief from the crowd. I was now above Og. Our turning movement confused me. The bottom of the arena was over my head in another instant; then the side and top swung past.

Og made another clutch at my ankles; and warned at last of some danger which I did not understand, I dropped him abruptly and swam away. He did not chase me, but turned over a few times more and then hovered in the center of the cube.

Into the upper foliage I swam. I was breathing heavily. My chest seemed constricted. I was not physically able to undergo such exertion without distress. I realized it. The excess oxygen my blood was demanding could not be obtained by my lungs from water. I would have to get my grip around Og at once.

Some of the spectators were now shouting at me derisively. They thought that after this first encounter I was now afraid of my adversary.

Afraid? I was beginning to be in truth. I ground my teeth, and turning, head downward, again dove for Og. He waited, quietly; he was tense again, his body slowly sinking.

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Ten feet from him, I brought myself up short. We faced each other, both sinking gradually. Once he slid forward, and made a pass at me with an arm. But I dove away, returning at once.

We were nearly at the bottom of the arena when Og suddenly threw all four arms above his head. His body was bent forward, crescent-shaped. It seemed to be my opportunity. I rushed at him. He retreated; and as I came into an upright position for another lunge, his body bent over me like a bow. One of his feet touched one of mine; and simultaneously his fingers struck my head.

For a brief instant I was conscious that his touch seemed to burn. A tingling shock ran through me. Then, inert and unconscious, my stiffened body sank slowly to the bottom of the arena.

V

I recovered my senses, and heard dim voices around me. I did not open my eyes, but lay quiet, half in a dream. I remembered the combat; I thought, perchance, I was dead. I recall now how vague musings floated through my brain. I had been alone on a meteor—then I found people—civilization. Unhappiness and strife had come with them. To be really happy and at ease, one ought to be alone in his world. And yet, there were friends to be found, as well as enemies. There was Caan, and the Marinoid Prince. He was my friend; he had warned me against Og. And there was love to be found too. Nona!

The thought of Nona stirred me to fuller consciousness. The voices around me seemed to grow louder. I opened my eyes.

I was in a bunk at Caan's house. Caan was there beside me—and an old, bent Marinoid whose work I knew was the care and treatment of the human body in distress.

Nona was sitting on the bunk close to me; her wonderful golden hair floated above us. Her face was white and set. As she saw me stir and open my eyes, she burst into sobs. My arms went up to pull her down to me. My Nona! And Caan. My friend Caan was gravely joyful to see me come back to life.

The old Marinoid was talking quietly to Caan about me, and then he left. Nona lay in my arms; presently the Prince sent a messenger to inquire if I were recovered. My cup of happiness was full.

It was far into the next time of sleep after the combat before I had regained my senses; and throughout all that time Nona and Caan had been beside me. I did not seem greatly injured. I was soon strong enough to talk with them, to find out what Og had done to me.

It was simple, and when I understood it I shuddered at the danger into which I had so rashly and ignorantly rushed. Og had shocked me into insensibility with a bolt of animal electricity. The bodies of all adult male Marinoids contain special electrical organs for the generation of it. The bolt can be released at will; its control is entirely voluntary.

Og had manoeuvered, I recalled at once, to get me into the right position to receive the maximum shock. His body was bent over me like a bow; he touched my extremities, with his extremities simultaneously; and the current, passing through my body, had all but stopped the beating of my heart.

Caan had thought I was on my guard regarding this. My words had made him think so; and I had refused to discuss the fight. And the Prince had meant to warn me of it.

I had indeed, heard of this natural weapon possessed by the Marinoids. But in my youthful confidence I had forgotten it, for the use of it against a human

(*Continued on page* 1179)

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(*Continued from page* 1170)

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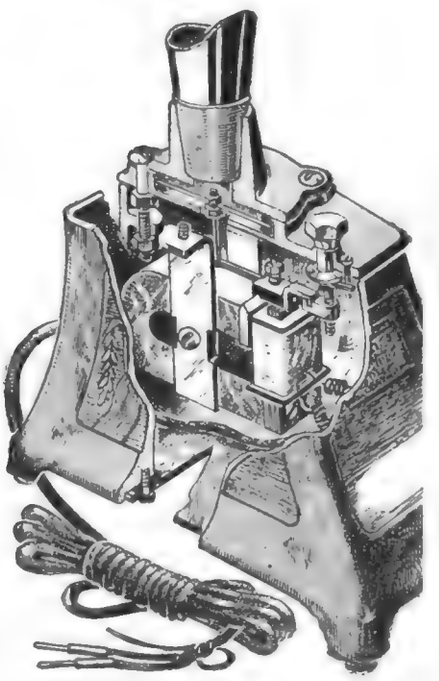

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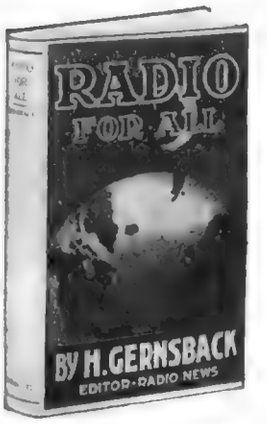

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The Man on the Meteor

(*Continued from page* 1177)

except in public mortal combat was a dire offence against the Marinoid laws.

THE ELECTRIC EEL

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And, to multiply instances, you have the *torpedo* and the whole family of *rays*. It was from them your scientist Galvani made his study of the electrical properties of muscles and nerves, applying his discoveries to the higher animals and to man.

I was soon recovered—and a wiser man than before. And I swore to myself that never again would I ignore the proffered advice of a friend.

My first desire was to fight Og again at once. With the knowledge of what I must avoid, I knew I could defeat him. I went to the place he lived, but he was not there.

The news that I wanted another combat—which was my right—spread through the city. Og had doubtless hoped I would die; when I recovered, and searched for him, he could not be found. After the next time of sleep, I learned he had left Rax. Shell-fish gatherers, working under Caan, reported seeing him swimming alone toward the Water of Wild Things.

He did not return. The region known as the Water of Wild Things was where he had been born, some said, and his only relations were among the half-savage beings living there.

I was content. With Og gone—my second fight with him, indeed was postponed for a considerable time—there was nothing in Rax to disturb my own and my Nona's happiness. We had our home, our love and our son.

VI

You have heard enough, doubtless. Let it rest there. And perhaps you are annoyed at some of the things I say to you? I am an old man now, and you Earth-people call me dogmatic. I am sorry. As you know, I have no patience with the man who scoffs because he is too ignorant to do otherwise; and I assure you I tell you these facts of my early life only because you ask for them and I think you may profit by reading them.

A moral? Everything is full of morals; and if you will but apply some of them to your own life, you will be the gainer.

(*To be continued*)

CREDIT TO OUR ARTIST

The author of the article entitled, "The Wonders of Saturn," which appears in the December, 1923, issue of SCIENCE AND INVENTION, Isabel M. Lewis, M.A., wishes to here give credit to Mr. Frank Paul, the artist who made the illustrations for that article.

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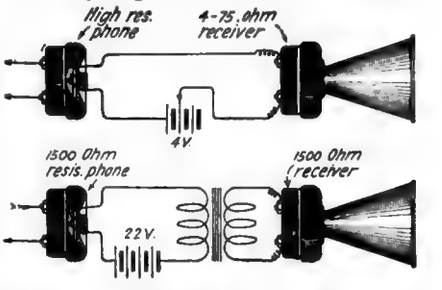

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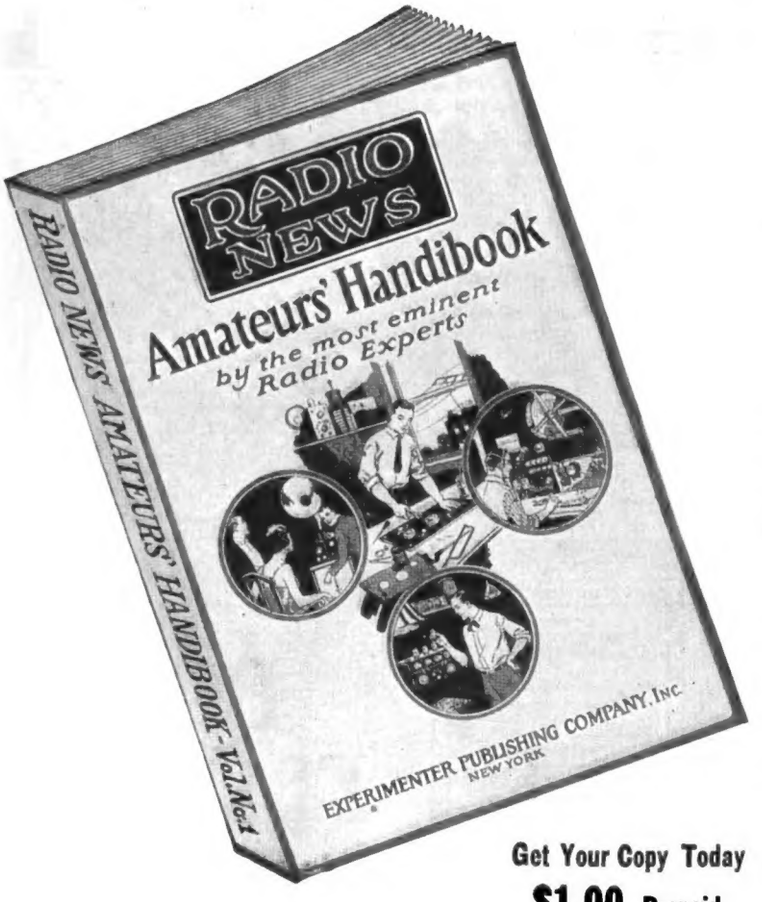
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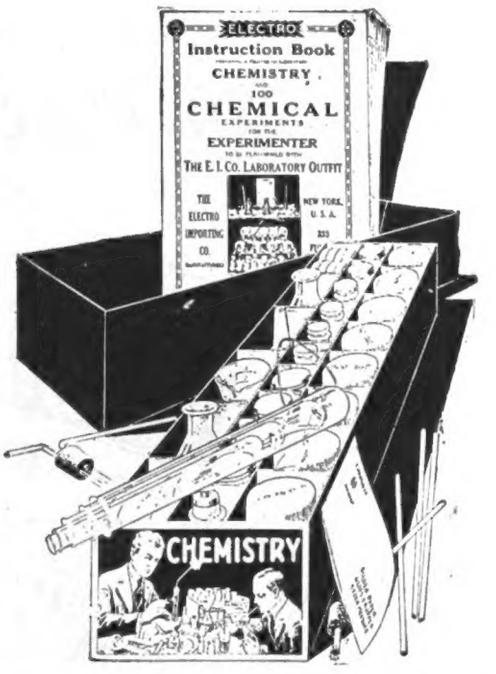

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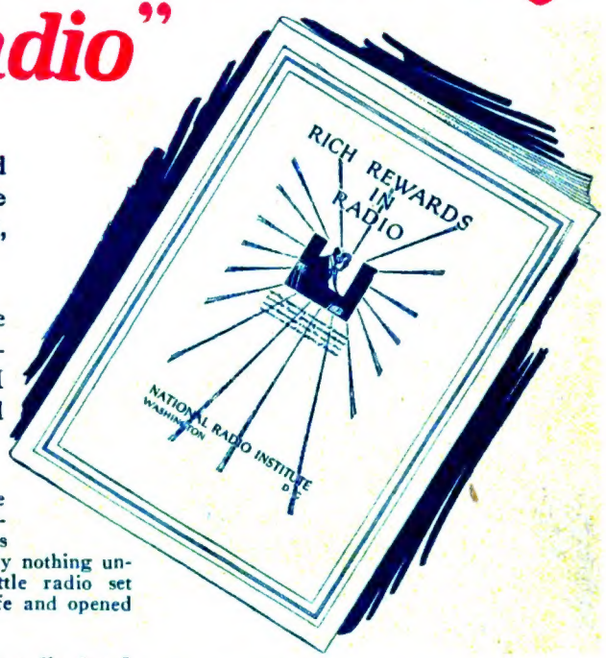

SIX months ago I was what you might call "a handy man about the office." I had what I considered a good job with a large manufacturing concern. Having taken a two years' business course, I knew enough of stenography and elementary bookkeeping to be of real value in general office work.

I took special dictation from the President, assigned general correspondence to the regular typists, was responsible for the purchase of office supplies, approved petty cash vouchers for the errand boys and clerks, and was entrusted with the responsibility of making deposits at the bank and bringing in the payroll.

In addition to these, I was often privileged to arrange accommodations for the President when he went off on a trip. And when he wanted some personal matter attended to, such as purchasing theatre tickets or having his evening clothes brought down to the office, I was always selected for such tasks. I was, in fact, an assistant to the President. And accordingly I was paid $40 a week.

I won't say that I was satisfied with this salary—although it was more than the other clerks were getting—but the fact that the President had confidence in me gave me a certain standing among the others which kept me fairly contented.

Then one day, having a little extra money on hand, I bought a small radio receiving set. Several of my chums had radio outfits and I had always wanted one in order to enjoy the broadcast programs in the evenings at home. There was ordinarily nothing unusual about this, yet that little radio set changed my whole slant on life and opened up my future overnight.

I didn't know a thing about radio, but I soon got onto the tricks of operating a receiving set and rapidly became a real "fan." But much to my surprise, I got more fun out of the mechanical operation of my set than I did from the music, speeches, reports and regular programs of the nearby stations.

Then I began to take my set apart, reassemble it and experiment. I rigged up an outdoor aerial and installed a tube set. Then I bought a loud speaker and gradually added part by part until I had a first class outfit with a wave-length capable of "picking up" the programs from distant stations.

Naturally, I didn't stop there. Several of my friends had "sending" sets and I wanted nothing less. I began to study the code and longed for the day when I could get a license and have a "call letter" of my own. My routine, humdrum work at the office began to lose its appeal. I could hardly wait until evening came so that I could get home to the "work" I actually enjoyed.

One day the traffic manager at the office mentioned that he was going to buy a radio and flattered me by asking my advice. I offered to help him select a set and install it. He told me to go ahead, rig one up for him and let him know what I wanted for my trouble. It wasn't trouble—it was *real fun*—and I made $30 for a single night's amusement.

That set me thinking. Why not get into radio in earnest? Two fellows I knew had given up office work and were making big money as Certified Radio-tricians. One was a salesman for a large radio manufacturer, with a fine office of his own in his home town; the other was a ship operator, traveling around the world, seeing the things I had always wanted to see—and getting *big money* for doing it.

I decided to study radio and train for a real job. But I wasn't in a position to give up my work at the office, for I had saved little or nothing, and had to contribute something at home every week.

Then one day I noticed an advertisement in *Science & Invention*. The heading first attracted me, for it read—"Men Wanted in Radio—You Can Train at Home for One of These Big-Paying Positions—This Free Book Will Tell You How." Here was a chance, I thought. At least it wouldn't cost anything to get the book for it was *free*.

I sent for the book—"Rich Rewards in Radio." That was six months ago. What this free book meant to me is best explained by the fact that, as a Certified Radio-trician, my income this year will be at least $5,000. And that's only the beginning. For I can already see the enormous possibilities for trained men in this fascinating, profitable profession. And I'm going to get my share of the big money being made by those who are "growing up" with this fast growing industry.

Thanks to the splendid training which I got from the National Radio Institute, *in my spare hours at home*, and with a Government First Class License in my pocket, the rest is up to me. But the opportunities for money, independence and success are unlimited in radio and I'm going to go the limit.

I won't attempt to tell you all the details of the wonderful opportunity that awaits you in radio. The Free Book of the National Radio Institute—the same one that I sent for—will tell you all you want to know. It showed me the way to *big money* in *radio*—it lifted me out of the rut of office routine and made me an expert in this fascinating profession. Why can't it do the same for *you?* It *can*—the 32 page, fully illustrated free book will tell you how. The coupon will bring it to you—without obligation. Why not send for it—TODAY.

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